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JOHN HAYS HAMMOND ON THE SOUTH AFRICAN MINING SITUATION.

THE VIEWS OF THE LEADING AUTHORITY ON THE WITWATERSRAND.

By Charles Buxton Going.

A YEAR ago, writing in this magazine, I used the expression: "Industrial ascendency, not political power, is the animus of modern international struggles. The statesman who directs policies, and the military leader who protects the peace and maintains the order under which alone industry can be established and bear fruit, have thus become servants of the engineer who carries on the actual wealth-making work." The year has ended in the sternest war of the last quarter century—a war springing solely from the struggle of the new spirit of industrial progress against the old forces of political repression. And sooner or later, by force of arms or by sheer moral power, the conflict is certain to end in the emancipation of enterprise and the freedom of engineering effort to develop to the utmost the economic resources of one of the richest mineral regions of the world.

To make clearer than ever the engineering relations of the new order in the Transvaal, Mr. Hammond, whose time did not permit him to write an article, has extended to me the courtesy of an interview explanatory of his annual report to The Consolidated Gold Fields of South Africa, Limited—a report which summarises the situation at the outbreak of the present war. The additional information obtained from Mr. Hammond makes clear the ways in which the industry on the Rand will be bettered by the establishment of good government in the Transvaal.

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Upon this interview this article is based. Mr. Hammond, as is well known, strictly avoids the discussion of the political aspects of the case, though, to quote his own words, "in the Transvaal, economics and politics are so closely connected that it is impossible to tell where one ends and the other begins."

For all statements of a political character, and particularly for the concluding portion of the article, as well as for the wording of the entire paper, the magazine and I are alone responsible.

The Witwatersrand, according to Mr. Hammond's report to the Consolidated Gold Fields of South Africa, Limited, produced in 1898 gold to the value of £15,141,376, being about 25½ per cent. of the total product of the world. If there had been no interruption to mining operations during the year 1899, the output would have exceeded £20,000,000. And it is interesting to note here that this entire output comes almost entirely from a territory lying within a radius of 25 miles from Johannesburg—indeed, 79 per cent. of it is derived from the "central section," stretching from Langlaagte Estate to Knight's, a distance of about 12 miles.

The relation of the Witwatersrand gold product to that of the world is shown in the following summary of the figures for 1898:

Witwatersrand	£15,141,376	25½ per cent.
America	13,419,000	22½ " "
Australia	12,844,200	21½ " "
Russia	5,099,880	8½ " "
Miscellaneous	13,113,544	22 " "
The World	£59,618,000	100 per cent.

The vast yield has been attained by continuous rapid increase since 1887, in which year gold to the value of £80,397 was produced. The entire yield since the inception of mining has been £76,720,000. Dr. Hatch, formerly one of Mr. Hammond's assistants, in THE ENGINEERING MAGAZINE for August last, estimates that within five years the output from the Witwatersrand fields will reach the enormous figure of £36,000,000 per annum.

The present situation of impending change is, therefore, one whose importance is not confined even to the enormous engineering and financial interests directly involved. Anything affecting the production of so large a proportion of the world's stock of gold must exert an influence extending throughout the whole range of economics. But it is the purpose of this supplementary and explanatory comment upon portions of Mr. Hammond's report, obtained in substance from

Mr. Hammond himself, to treat only of the direct bearings of the present war upon the mines and mining conditions, regarded from a purely professional standpoint.

First and foremost: the question presents itself as to the immediate fate of the mines and the vast mechanical installations thus clustered about one of the foci of the Boer activity. Will they suffer destruction, as has been threatened (according to newspaper report)—will they be seized and worked in the interest of the Boer government—or will they merely lie idle and take only the damage due to neglect? Unfortunately, no direct answer seems obtainable. It is not to be believed, however, that any destruction of equipment could receive official sanction. In the first place, contrary to the generally received opinion, the ownership of the mines is vested chiefly on the Continent. British interests are a minority only, the majority of the shares being held in Germany, France, and other European countries. Even should the Geneva Convention exercise but little influence upon the conduct of the Transvaal officials, the large neutral interests involved would deter the heads of the government from directing or sanctioning any wrecking of property or plant. Whether or not the recklessness and lawlessness of the lower elements of the community could be restrained is quite another matter. The Young Boer partisans are hardly likely to weigh very accurately proportionate ownership or the after consequences of wreaking their bitter feelings on the nearest tangible object identified, in their minds, with their enemies. No great confidence can be felt, therefore, that the heads of the government will be able, even if desirous, to protect the mine property from injury. Wholesale destruction is not to be apprehended, but more or less vandalism of a desultory character. For the present, it is likely (as reported) that some of the mines (though only a very few) will be worked for the gold needed by the Boer government, and that such work will be so prosecuted as to yield the largest immediate returns. Only the richest ore is likely to be taken, regardless of good practice or ultimate economy; no attention to maintenance or repairs can be expected; it will, beyond question, be a systematic robbing of the mine and driving of the machinery to death. The removal from the country of most of the competent mining engineers would prevent any general continuance of the industry, but there are enough miners in the Transvaal to carry on, upon a very small scale, such work of this character as is likely to be attempted.

As for the neglected mines, they will not suffer as seriously as would be the case in some other localities or in different formations.

Water is not so troublesome as in many other mining districts, and the mines could be pumped out and operations resumed without inordinate expense. In this regard, the Witwatersrand is much more favourably conditioned than Kimberley, where the character of the mining and of the formation involves grave damage from the filling up of the mines with water.

The mines themselves—the underground workings—are, of course, not much subject to damage. They will remain, and will be reopened and eventually worked under a better order of things than any that has heretofore existed.

While it is to be regretted that the desired economic reforms could not have been attained by peaceful means, there can be no doubt that, having regard to the financial aspect, the drastic measures finally adopted will be ultimately of far greater benefit than the economic reforms which otherwise would have been grudgingly granted. The amelioration of conditions, consequent upon good government, will most materially enhance the value of the properties of the Witwatersrand district. Not only will there be a direct saving per ton of ore treated, but the tonnage of payable ore will be thereby considerably increased.

At present, in the existing mines, there are large quantities of ore of comparatively low grade—say five or six dwts., or about twenty shillings to the ton—which now would not pay to work, even with the reduced working costs which, in recent years, have been attained in spite of scarcity of labour and other disadvantages. What has been done is indicated by the fact that, though the value per ton of ore crushed was 2s. 2d. less in 1898 than it was in 1892, the dividends per ton of ore crushed were 13s. 2d. in 1898, as against 8s. in 1892. Only 19 per cent. of the gold won was distributed in 1892, while 32 per cent. was distributed in 1898.

The sum of 6s. per ton would be a conservative estimate of the direct and indirect benefits of good government. This saving would be equivalent to an enhanced profit per claim of £7,500 to £12,000, and would result in an increase of annual dividends by £2,199,434, based on last year's tonnage of ore crushed. The low-grade ore already referred to in the present mines will be handled through the same shafts, by the same machinery and plant, and to a large extent on the same working expenses already paid by the higher grade. There are also large unopened zones of poorer ore, which may become payable under better conditions. It will, however, take several years fully to realise the saving in question.

The mining economies directly secured by the removal of the present abuses will be in connection with the cheapening of costs of mining supplies, especially of dynamite; with the suppression of the traffic in stolen amalgam and gold; and with the improvement in the labour situation, with which is closely connected the regulation of the traffic in liquor, which, as it has been illicitly carried on, has been a costly item to the mining companies and the cause, as well, of many accidents. The excessive cost of dynamite has been the subject of much discussion and requires no additional comment. It was fully discussed by Dr. Hatch in THE ENGINEERING MAGAZINE last August, and in the same article he reviewed clearly the burden of exorbitant railway charges and their effect in raising the cost of coal and all stores and machinery.* Less prominence, however, has been given to the other points mentioned. The traffic in stolen amalgam and gold is extensively carried on, and its suppression by the co-operation of an honest and competent government would result in a large addition to the revenues of the mining companies. It can exist only through the neglect and indifference of the government officials. Proper regulations, properly put into effect, with a suitable detective force, would make it as impossible to rob the gold-mining companies as it is to rob the diamond mines in Kimberley. Any honest owner can readily account for property of this character, and no other should be able to find a market. In a great majority of instances, the mere possession of such materials is *prima facie* evidence of theft; but so long as the law is lax, the police indifferent and dishonest, and the market free, the companies must suffer.

The labour question has been of the greatest importance in the district. The inadequate supply of native labour has necessitated the undue use of machine drills in mining, resulting in the breaking of a large proportion of barren ground, and in the creation of waste in the ore—which has, in turn, caused a diminution in value. During the continuance of the conditions heretofore existing, no improvement in the labour situation could be expected.

The trouble is not in any lack of suitable material. Black labour is to be had in any quantity, under proper conditions, and the best of it is excellent in quality. The trouble is that conditions have been so bad that none but the lowest element of the blacks would submit to working in the Transvaal, and even these hardly at all except under pressure of absolute necessity. Abuse, extortion, enforced la-

*The Witwatersrand Mines and the Boer Government. By Dr. F. H. Hatch. THE ENGINEERING MAGAZINE, August, 1890, pp. 812-817.

bour on the farms without pay, trickery, robbery of their accumulated earnings by Boers—these have not attracted the negro to the South African Republic. No doubt the regulation of political conditions as between the two races is a difficult one, but the Boer of the Transvaal has not even approached it. Oppression of the blacks has ruined the labour supply of the Witwatersrand, and not the least benefit of a good, honest, and just government will be the amelioration of conditions in this respect. A "hut tax," by which the negro is made to supply some share in the support of the government, and in return for which he receives protection of law, seems to be one of the most successful methods of raising the standing and increasing the responsibility of the native.

There has been, heretofore, not only lack of good legislation but utter laxity in the enforcement of such law as there is. To this is attributable the deplorable condition as regards the liquor traffic. The statutes are nearly prohibitive, so far as the sale of liquors to natives is concerned, but there is not even a pretence of enforcing them. It is no uncommon sight to see, on a Sunday afternoon, a hundred Kaffirs, miserably intoxicated, with broken heads and eyes nearly knocked out as the result of drunken fights. The liquor is an abominable whiskey of local manufacture, made and supplied often by the very men who preach religion and temperance to the negro.

The peculiarly bad conditions affecting the mining industry are confined to the Transvaal. In the other Dutch republics such flagrant abuses do not exist, and the consequent change in governmental conditions will be correspondingly less. But there will be an indirect benefit at Kimberley from reduced cost of political administration, which will not be without influence.

The temporary suspension of mining activity affords an opportunity to review the tendencies, apparent in mining practice in the Rand, toward the development of the deeper levels. So far, no difficulty has been experienced, either from high temperature or from influx of water, in sinking to depths of 3,700 ft., and Mr. Hammond is still of the opinion that it is possible to work to depths of upwards of 8,000 ft. in the Witwatersrand district. The extent of mining ground embraced within vertical walls of 8,000 ft. cannot now be predicted with any accuracy. In some of the deeper shafts, zones of poorer ore have been encountered, but this is only in conformity with Mr. Hammond's idea of the geology of the banket formation.*

* The Gold Mines of the Witwatersrand, South Africa. John Hays Hammond. THE ENGINEERING MAGAZINE, Feb., Mar., 1898.

It enforces, however, the idea of carrying out development work as far as possible in advance of milling operations, so as to provide against the contingency of recurring zones of poorer ore.

Certain instances of local steepening of the reefs are only the counterpart of experiences falling to the outcrop companies, and Mr. Hammond still holds strongly to the opinion which he has always maintained—that there is a decided tendency, broadly speaking, for the reefs to flatten in depth. He makes a sharp distinction between a *tendency* to flatten, which is perfectly consistent with all the observations, including the few local exceptions, and a *uniform* or regular flattening, which would be inconsistent with the accepted geological theory. In any case, even the local steepenings are flatter than the outcrop.

The large capital expenditures connected with the mining of the deeper areas require the exploitation of large blocks of claims, and lead Mr. Hammond to recommend the employment of large batteries and shafts, and of mining plant of commensurate capacity. The improved conditions anticipated in the future will more than compensate for the delay in starting operations on the deeper levels.

Captain Mahan, in THE ENGINEERING MAGAZINE for January, 1899, said: "We have two great examples of colonial policy. Great Britain has been, in the main, and increasingly, beneficent and strong. Spain, as the records show, was inhumanly oppressive to the inferior races. But, still more, Spain became weaker and weaker as the years passed, the tyranny of her extortions being partially due to exigencies of her political weakness and to her economical declension. Let us, however, not fail to observe that the beneficence, as well as the strength, of Great Britain has been a matter of growth. * * * Materially, the interest of the nation is one with its beneficence; but, if the ideas get inverted, and the nation sees in its new responsibilities, first of all, markets and profits, with incidental resultant benefit to the natives, it will go wrong. Through such mistakes Great Britain passed. She lost the United States; she suffered bitter anguish in India; but India and Egypt testify to-day to the nobility of her repentance. Spain repented not. The examples are before us. Which shall be followed?"

The remarks, addressed to the United States with reference to the newly acquired dependencies, apply to England to-day. She has not embarked on any war of conquest and aggression, but upon a definite undertaking to right intolerable wrongs, to bring liberty and justice in place of oppression and extortion, and, to quote Mr. Chamberlain, "to do for others what we claimed for ourselves."

Whatever the outcome of the present struggle, her statesmen must not and will not forget their aim, nor be blinded to it by greed of acquisition. The Boers are struggling for independence, as they conceive it. Their fatal mistake has been in seeking independence to do wrong. England's mistake would be equally fatal if she attempted anything but the good of any territory coming under her control.

It must be understood that there is nowhere a people more capable of self-government than the better element of the South African white colonists, nor any more determined to secure the ends of freedom, justice, and equality for all the white races. They would be as intolerant of oppression under one national dominion as under another, and sheer force of numbers and moral power would eventually overthrow any tyranny or any influence obstructive to the best governmental ideals and administration. Mr. Hammond declines to discuss the political aspects of the present situation, but competent authorities agree that the future points to an African federation of self-governing states, Imperially connected, probably, with the British throne, but with the largest measure of freedom. Any attempt at coercion from without would be more quickly and more vigorously resented than even the oppression of a domestic oligarchy.

The solution of the present crisis will, no doubt, have a strong, though indirect, influence in that development of the African continent of which Cecil Rhodes is the leading exponent. It is not to be believed for a moment that he—or any association of men—has directly influenced the precipitation of the present struggle, nor that it would have been possible for him to do so had he been disposed. It is part of an organic progress toward fuller life, in a region destined to play a large part in the world's economic future. Mr. Rhodes is keen to discern the march of events, and to place himself in the lead in ordering and directing them. The Boer government has been in the hopeless attitude of striving to stay them.

It is obvious that the whole world is vitally concerned in the wise and permanent adjustment of the South African problem. It is an economic question, in which the engineer's insight is clearest and his influence strongest. Every man in the profession should array himself on the side of sound and enlightened policy, to the end that the English Government may not only make such a policy the basis of its dealings with future Africa, but may clearly and promptly declare the justice, honour, and liberality of its purpose, and so enlist the moral adherence of the civilized globe. Industry rules the world, and industry is founded on freedom.

MECHANICAL TRANSPORT APPLIANCES IN ENGINEERING WORK.

By A. J. S. B. Little.

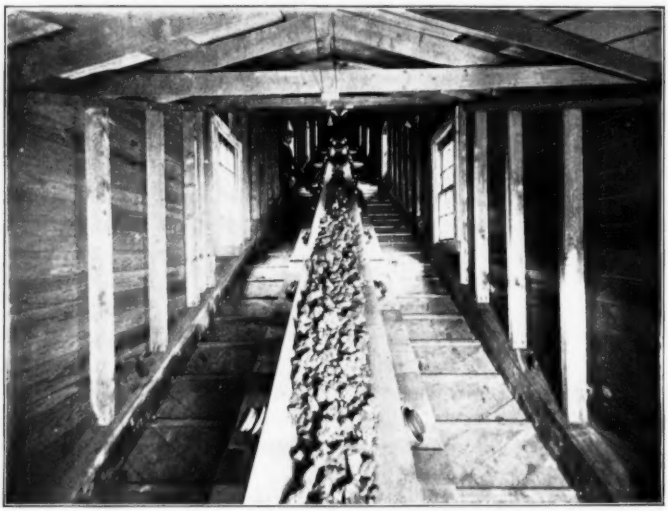
IN the preceding issue of this Magazine I pointed out the too general apathy of engineers—especially in manufacturing works—to the vast advantages to be gained by the intelligent use of transport appliances, and I endeavored to show, by specific examples, the labour-saving and cost-saving value of conveying machinery.

There is not space at disposal to give even a summary of the industries in which the transport-machinery specialist, by the successful introduction of automatic distributing machinery, has altered the method and reduced the cost of working; suffice it to say that wherever matter has to be shifted mechanical appliances are applicable and the question left for consideration is: "Will such a plant pay?" In presenting details of a few installations, therefore, due consideration has been given to selecting those most likely to interest a large class of engineers, and the figures given will probably guide those contemplating extensions or alterations on similar lines. It is well to remember, however, that the more successful a new system turns out, the greater becomes the difficulty in getting figures from the users.

In handling coal to boilers, the fundamental principle to observe is expedition. This, combined with a well-located store of ample capacity, filled automatically, results in a good labour economy.

A boiler house situated on the Tyne, having nine boilers fitted with automatic stokers, is supplied with coal through travelling hoppers, suspended from overhead coal bunkers filled with fuel from a push-plate or drag conveyor placed longitudinally above them and fed from an elevator situated on the wharf. The coal is "grabbed" out of the barge, raised by a steam-driven crane, and dumped into a weigh hop-

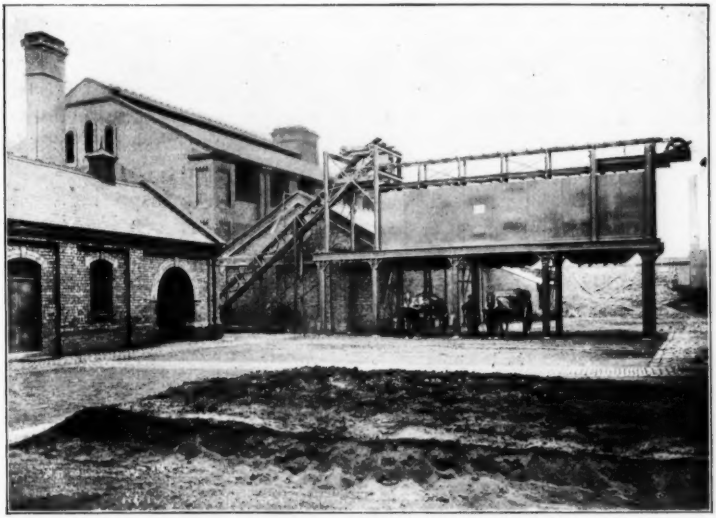
per of 3-tons capacity. The crane man has under observation the spring balance attached to the end of the beam and after registering a charge he can discharge the coal from the weigh hopper to a fixed coal pocket on the elevator boot. Thus the elevator has a load on sufficient to last till the next weigh has been made. The elevator has a double strand of chains (each having working strain of 1,500 lbs.) which carry the 24-in. wide buckets, pitched 2 ft. apart, the whole being capable of lifting 40 tons an hour. The conveyor is of scraper design, with lattice framework and noiseless wood guide paths. The pioneer



COKE CONVEYOR, NEW ENGLAND GAS AND COKE COMPANY'S WORKS, EVERETT, MASS.
Length, 200 ft.; angle, 21°; width of belt, 24 in.; speed, 500 ft. per minute; capacity, 200 tons per hour. For use as a picking or sorting belt, these conveyors are designed with two flat pulleys instead of one. Robins Conveying Belt Co.

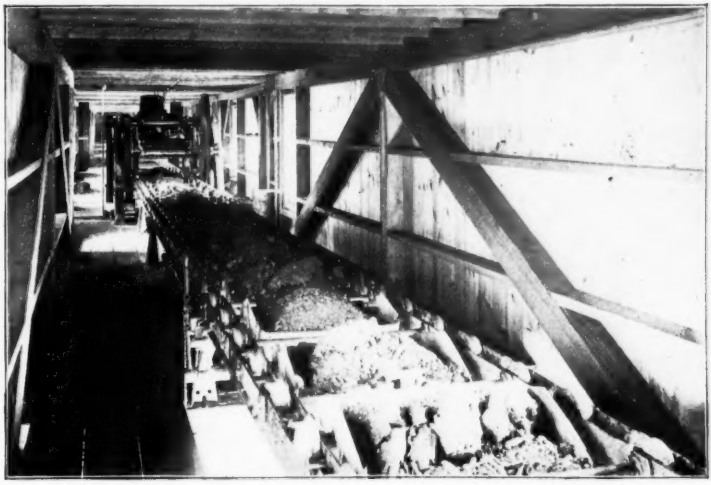
users of this style of conveyor were greatly troubled by the noise which was produced when working. Still this conveyor might appropriately be called a "howling success," and certainly it proved the forerunner of conveyors which are now made with every wearing part renewable and all parts in sliding contact lined with hard wood. The shoots serving the stoker hoppers with coal are made to swivel as well as travel; thus full advantage can be taken of each hopper which, by means of the oscillating movement thus obtained, is perfectly filled.

A request for figures of working cost was met by a refusal, supplemented by the explanation that it was against the rules of the firm to



CHAIN-DRIVEN COKE CONVEYOR, LEIGH GAS WORKS, LANCASHIRE.

The same style of plant is used for ash, quartz, bones, etc. The New Conveyor Co., Ltd.



COAL CONVEYOR FOR THE BOSTON & ALBANY R.R., AT ALSTON.

The C. W. Hunt Co.

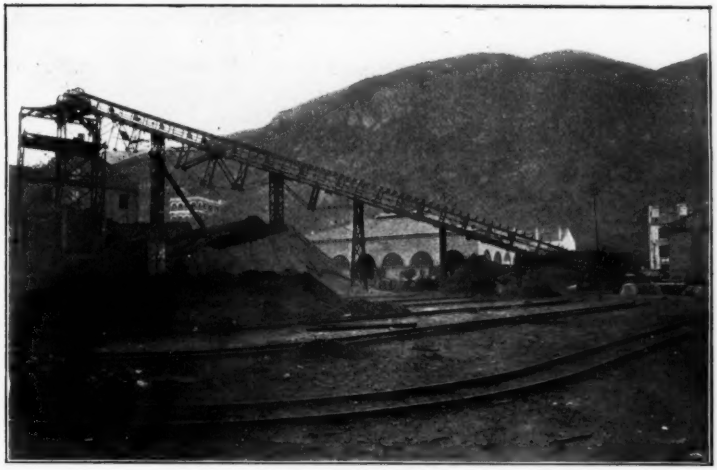
supply any information respecting plant adopted by them; but it may be interesting to know that the cost of this coal-handling plant, erected complete, was about £730. The man who looks after the machinery, in his spare time drives a car or acts as conductor, cleans lamps and mends drains—in fact, does all the odd jobs on the works.

In handling coke it is essential that the form of transporting appliance adopted should have few wearing parts, that all of these be kept

COAL CONVEYOR OF THE BOSTON & ALBANY R.R., AT BOSTON.

The cut shows the long run of the conveyor, which is of the noiseless type, the buckets being carried by wheels at the sides. The C. W. Hunt Co.

as free from grit as possible, and that they be get-at-able and simple, to facilitate and cheapen renewals. The latest conveyor which is illustrated in this article is for handling hot coke received direct from retorts. It will be noticed that the bottom of the trough has a raised part running the whole length and forming, at each side, small gutters, into which the coke dust falls and along which it is conveyed by means of pushplates or scrapers to the breeze or dust-collecting box

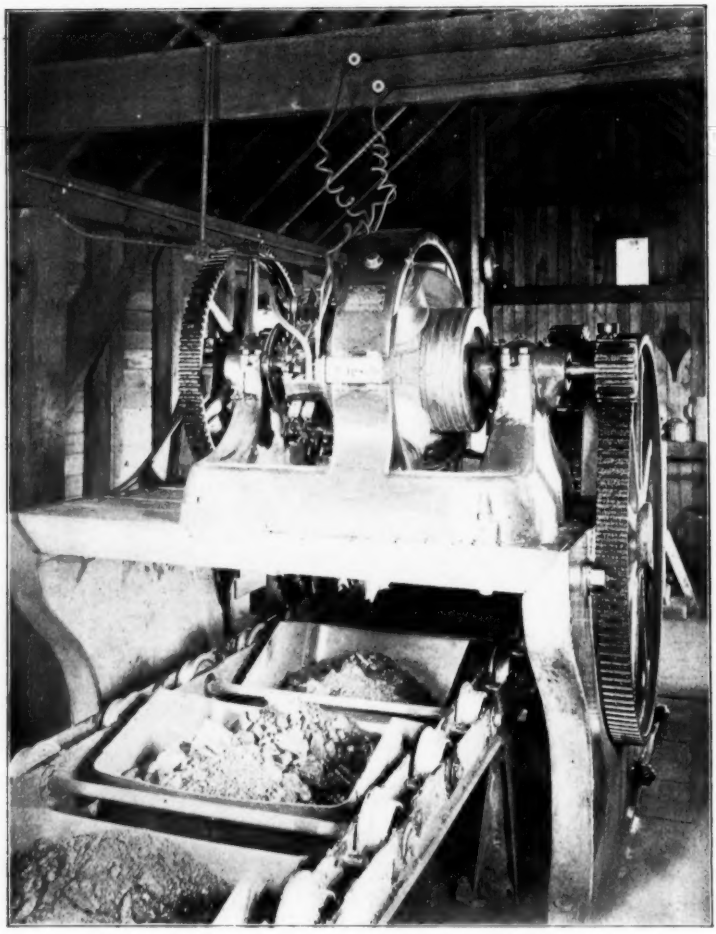


AN INCLINED COAL CONVEYOR IN CHINA.

Carries coal to storage heap, discharging through any portion of bottom trough. Blake, Barclay & Co.

BELT CONVEYOR AT A CULM WASHERY, PENNSYLVANIA COAL CO., PITTSTON, PA.

The culm is fed to the conveyor by a movable hopper, thus insuring even delivery to the belt and to the screens in the washery. After each full cut by the steam-shovel the movable conveyor is shifted bodily, sideways, close to the bank again. Length of conveyors, 250 ft. each; width of belt, 24 in.; speed, 600 ft. per minute; capacity, 250 tons per hour. Robins Conveying Belt Co.



DRIVING MECHANISM OF A NOISELESS COAL CONVEYOR.

The plant is that of the Boston & Albany Railroad, at Boston and is electric driven. The C. W. Hunt Co.

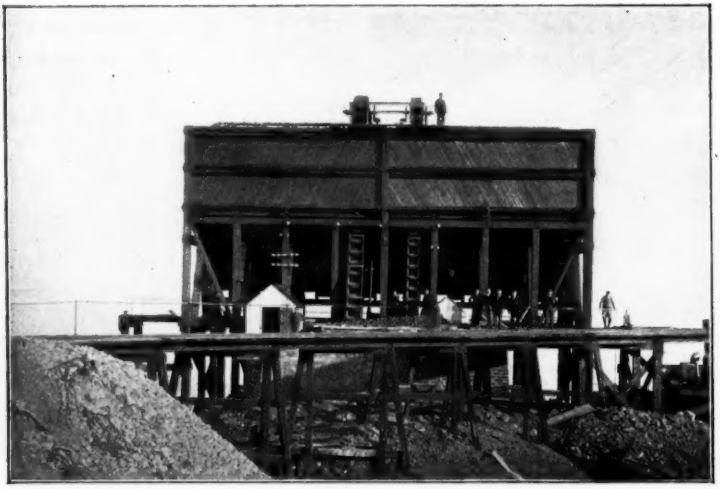
fixed at the delivery end. The part of the trough on which the endless chain slides is lined with Australian "iron-wood" in double strips, the top strip secured to the under one in a way which admits of easy and cheap renewal. The chain is formed of alternate ordinary oblong

links and flat-steel-section bar links, each of the oblong links being made from a bar of round steel bent to fit the openings in the flat-bar links. After the round links are threaded through the openings of the flat links, the openings in the latter are closed over by a cover plate;

BELT CONVEYOR WITH SELF-MOVING TRIPPER FOR INTERMEDIATE DISCHARGE.

The tripper is moved forwards or backwards by gearing the driving wheels with one or other of the large pulleys over which the belt passes, and which have opposite directions of rotation. Reversal can be made automatic. Length of conveyor, 100 ft. at 18° and 60 ft. level, width of belt, 18 in.; speed, 500 ft. per minute; capacity, 80 tons coal per hour. Robins Conveying Belt Co.

and on the top of this cover plate there is fixed to each flat link another plate of the proper width to work in the trough. These coke-carrying plates are about an inch longer than two links, so that a neat joggle is formed to overlap each plate, which presents a nearly level steel-belt surface on which the hot coke is conveyed at about 30 ft. per minute. The dust, formerly so detrimental to chains unprotected from coke grit, falls into the gutters, whence it is removed by the push-plates, fixed at intervals of 4 to 10 ft., to the underside of the plates, so that as the machine is at work conveying and slaking the coke along the trough, the push-plates or scrapers also shovel the coke dust along the gutters, and deliver it out at the end of the trough. The endless chain



SCREENING, BREAKING, ELEVATING, CONVEYING, AND STORING PLANT FOR LIMESTONE HANDLING.

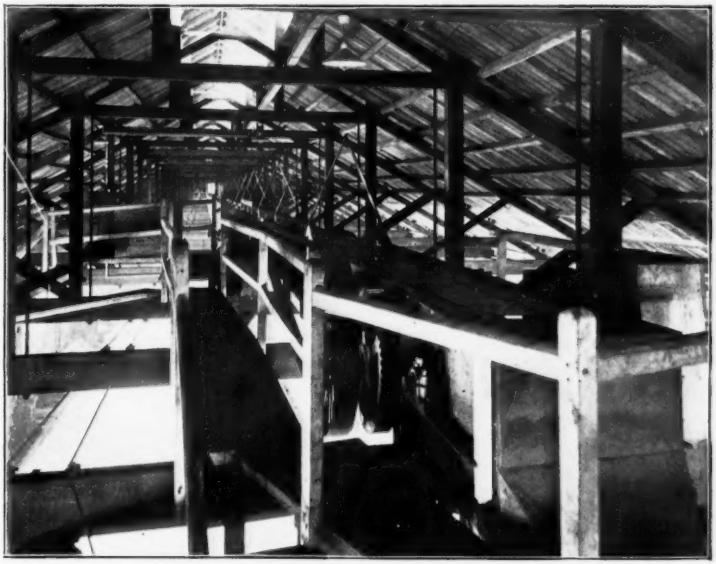
North Lonsdale Iron & Steel Company's Works, Ulverston, Lancashire. 15x20 in. push-plate conveyors and elevators to large hoppers. Enables boats to come in, load, and depart on one tide. New Conveyor Co., Ltd.

OPEN-TOP CARRIER FOR CONVEYING PHOSPHATE ROCK.

The plant is that of the Florida Central & Peninsular R.R., Fernandina, Fla. It carries from cars to storage buildings, or thence to vessels, or direct from cars to vessels. Capacity, 200 tons per hour. Overlapping buckets 18x36 in. are carried on self-oiling rollers. Stock cannot fall between them. Link Belt Engineering Co.

travels on the wood paths all along the trough, and round the driving or end drums in the usual way, and back over the rollers carried by hangers under the trough, these being securely braced.

This conveyor discharges into a large hopper over elevator, the coke being fed with surprising regularity by means of a side-jigging feeding shoot which effectually prevents choking, even with large pieces of coke passing through the buckets. It is not unusual to see 10 tons of rough coke stacked over the elevator boot and the whole plant worked by one man. The elevator, which is usually about 50



DRIVING END OF A 275-FT. CONVEYOR, 30-IN. WIDTH.
The conveyor has triangular ploughs, and deposits material at any point desired.
The New Conveyor Co., Ltd.

ft. centres, discharges onto a plate carrying conveyor, from 2 to 6 ft. wide, carried over the coke-storage yard; at one point on the line of the conveyors the coke is discharged over a screen and graded into hoppers under which carts, trucks, barges, or bags are placed. The operation of filling these is performed by pulling a lever from the ground level, takes no appreciable labour, and consumes less than a minute.

In a gas works where, say, 60 tons of coke have to be removed in the 24 hours, the complete system could be started up for £2,000—or,

MECHANICAL ORE-HANDLER AT A RUSSIAN IRON WORKS.

The plant is at Mariopol, at the furnaces of the Société de la Providence. Installed by Brown Hoisting & Conveying Machine Co.

say, half this sum if only the outside screening and stacking arrangement were adopted; in this case barrows or tipping trucks would be requisite to bring the coke from the retorts to the elevator hopper. The complete installation, after taking all repairs into account, effects a saving of at least 1s. per ton; from figures given me by Mr. Hack, of Saltley Gas Works, Birmingham, I find that the outside plant shows a saving of 7½d. per ton, after deducting cost of all repairs; further, Mr. Hack states he would strongly advocate the introduction of similar machinery even if there were no saving, as it so greatly lightens the men's work and reduces the number of labourers, which is important in the winter time when great difficulty is experienced in finding sufficient men to do the work.

The illustration of the coke plant at Leigh was taken 7 years ago and the conveyors are still working daily. It is hardly necessary to describe how ashes can be similarly conveyed, pocketed, and shot into carts, at a reduced cost, as arrangements can be seen in operation in most districts. A good ash plant costs about £300, and the saving in labour and other costs varies considerably with local conditions.

At a steel works in the Midlands a new idea has been put into execution, whereby the slag is made into a marketable product. Trucks

from the converters are emptied into a pan mill, and the triturated slag is dropped onto two cotton-band conveyors, 12 in. wide x 40 ft. long, which discharge into elevators having 12-in. wide buckets to lift the powder to a height from whence it is conducted through funnels to the weighing machines, where it is bagged and trucked. The small pieces of slag from mill gravitate to two 12-in. wide steel-belt conveyors, 60 feet long, which are relieved of material by other 12-in. elevators having discharge into tiger mills situated over weigh machines; these mills work simultaneously with those handling the powdered slag from the pan mill. The wear-and-tear is greater than in a coal-handling plant, but it is not excessive, no renewals having been required during the three years the plant has been at work. There is no limit to the magnitude or capacity of automatic conveying and elevating machinery. A plant in Hongkong takes coal from boats through a culvert under three streets, a distance of two miles, to storage ground where smaller elevators and conveyors distribute it at rate of 50 tons an hour.

In steel works, the gas producers are charged automatically as fol-

ORE-STORAGE AND REHANDLING PLANT.

Erected at the Duquesne furnaces of the Carnegie Steel Co., and now being duplicated for the Dominion Iron and Steel Co., Cape Breton. By the Brown Hoisting & Conveying Machine Co.

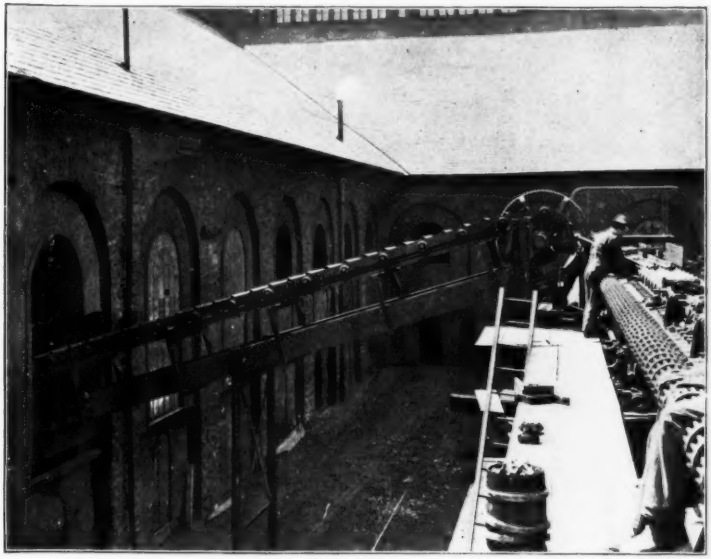
lows: With seventy-eight producers laid out in three rows, each row has erected over it a lattice-braced structure, carrying a measuring box placed over every "bell mouth" in such a manner that "tickling" of coal is not interfered with; the chambers hold about 10 cwt. and are filled by conveyors and elevators, the arrangement being quite automatic and laid out as follows: Trucks of small coal are shunted to a coal road and passed over hydraulic rams, which kick-up one end and shoot the coal into large hoppers, underneath which is a slow-running plate conveyor 3 ft. 6 in. wide, which regulates the feed to an elevator having buckets 36 in. wide. This lifter is located centrally to producers

SPECIAL GANTRY CRANE FOR MOVING STEEL RAILS.
Installed at Pennsylvania Steel Company's works, Steelton, Pa. Span, 200 ft.
Brown Hoisting & Conveying Machine Co.

and is 60 ft. high; it dumps into a cross conveyor of push-plate design. The elevator boot is 17 ft. below rail level, and has fixed between it and the feeder belt a screen, which is used when small coal is scarce and "tripping" or unscreened coal has to be used. The coal, passing over this, is fed to a crusher and the small coal falling through the jigger goes direct to the elevator. The conveyor at the elevator head, 32 ft. above rail level, is of push-plate design, 24 in. wide and 66 ft. long, made with three outlets to feed the conveyors fixed in line with each row of producers, to take the coal to right and left of elevator. These conveyors vary from 160 to 360 ft. in length and are 15 in. wide, of

scraper design, and made to drop the coal at will to any of the 10-cwt. measuring chambers. The total length of the five is 1,400 ft. and they will convey 50 tons per hour, requiring 52 b. h. p. to drive them. The power is produced by six electric motors of the enclosed type. To put up a similar sized installation would cost from £5,500 to £6,000, including everything except producers. Wear would not be noticeable, and might be put down at £20 a year.

Wire ropeways on any of six systems described below are most

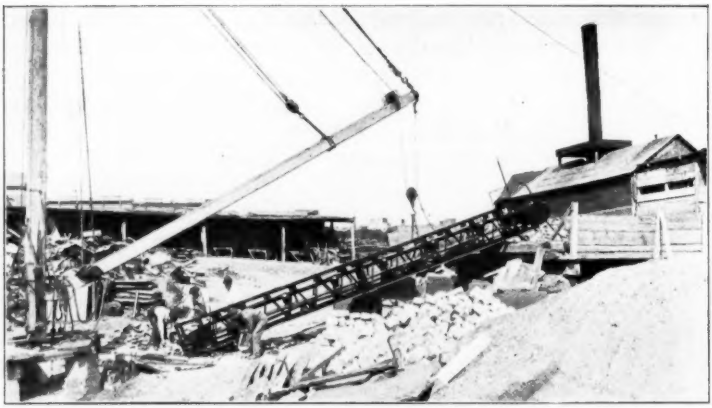


STEEL-BILLET CONVEYOR AT BETHLEHEM IRON CO.'S WORKS, SOUTH BETHLEHEM, PA.
The conveyor, 90 ft. centers, receives billets after passing through shears, and delivers them to live rolls. Link Belt Engineering Co.

serviceable, doing excellent work with a reasonable outlay at a comparatively low working expense. The different styles are:

(1.) Endless running rope with carriers hanging therefrom and moving with it through frictional contact; this form is applicable where the quantity of material to be carried does not exceed 500 tons per 10 hours, where the conveyor is to work horizontally or at an angle not exceeding 1 in 3, where the individual loads are less than 6 cwt., and where the section of ground does not call for spans of greater length than 600 ft.

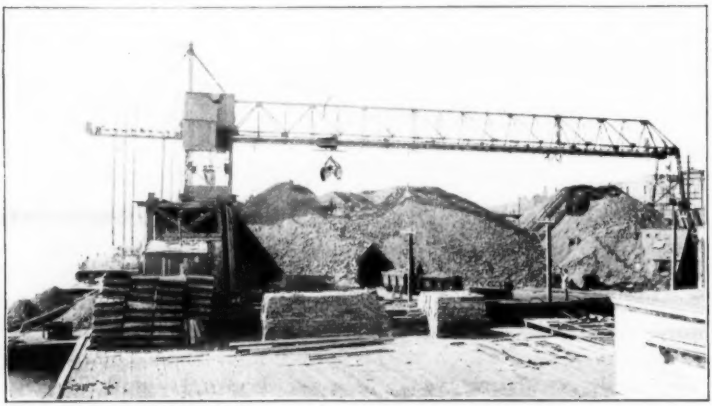
The chief wearing part is the rope. As an example of the life of a



SELF-CONTAINED PORTABLE BELT CONVEYOR.

24-ft. conveyor, with small direct-connected engine mounted on 35-ft. steel truss. For cellar excavation, unloading vessels, etc. Robins Conveying Belt Co.

plant of this character an instance can be cited of a line in Spain, constructed on this system, carrying 500 tons a day over a mile length, where the rope carried over 160,000 tons, representing an outlay of about ¼d. per ton per mile for rope renewal. Including all renewals, but not figuring on fuel, the average cost for transport per ton per mile works from 2d. to 4d.

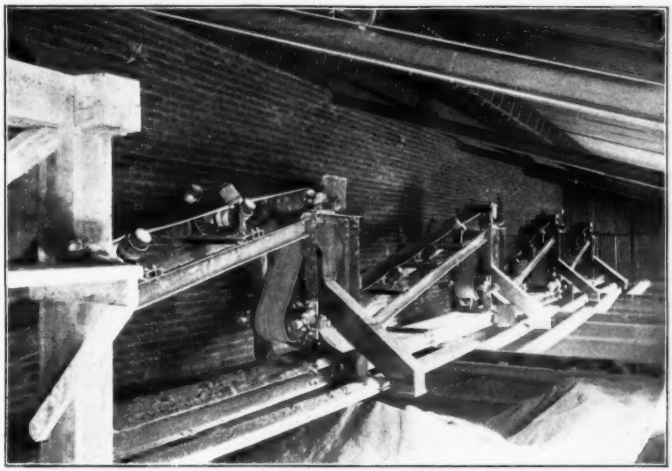


COAL-HANDLING PLANT, WEST END STREET RAILWAY COMPANY'S WHARF, BOSTON.

The plant is operated by an electric hoist, and equipped with self-filling clam-shell buckets and Miller-Covell double-swing fall-rope carrier for supporting the slack ropes.

(2.) Endless ropeway with hanging carriers rigidly fixed and moving with rope: this does work similar to that performed by the first type and is especially suitable for working over steep inclines with many and sudden changes of level. Unloading can be performed automatically by a catch bar striking the carrier and opening or tilting it. It is difficult to load, the operation being accomplished by complicated and more or less ingenious devices to fill the buckets while going round drums or at a point adjacent thereto.

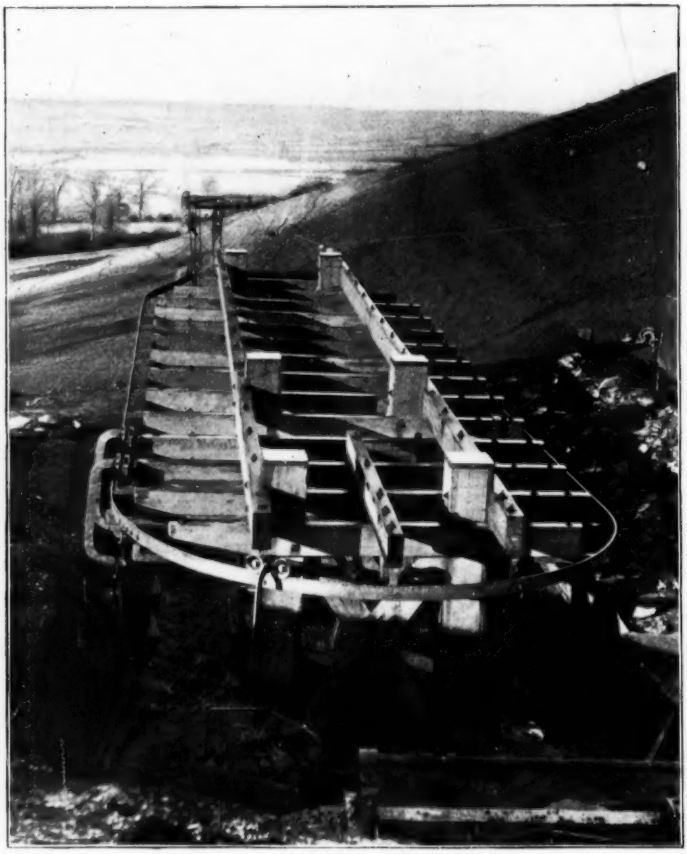
It is not unusual to have an arrangement of loading hoppers travelling at the same speed and actuated by the rope. Complications can



CONVEYOR WITH AUTOMATICALLY REGULATED DISCHARGES. NEW JERSEY ZINC CO., HAZARD, PA.
Four fixed trippers automatically fill each bin in turn. As soon as a bin is full the material backs up in the spout and returns to the belt, which carries it to the next tripper, and so on. The discharge can also be manually regulated by cut-offs. Robins Conveying Belt Co.

be avoided by making the rope run at speed approximating 2½ miles an hour, which renders loading simple and dispenses with automatic gear.

(3.) The endless fixed carrying rope and endless moving drawing rope, for employment where the quantities exceed 400 tons a day, and for overcoming difficulties which system No. 1 cannot surmount. While it is economical in wear and tear, the initial outlay is sometimes large. On one line constructed on this system, the power generated by descending loads was so great that it was necessary to absorb the greater portion of it and the difficulty was overcome by the introduc-



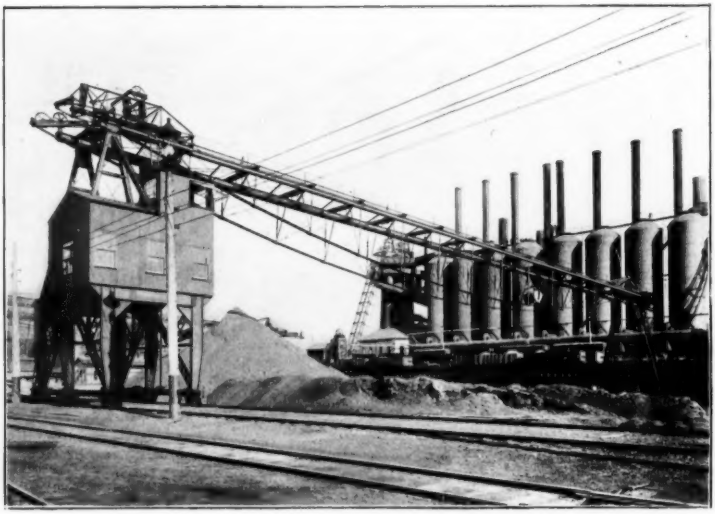
ROPEWAY IN WARWICKSHIRE FOR CARRYING IRONSTONE.
The capacity is 200 tons per day. The view shows the method of loading.

tion of a water brake, in which a revolving fan drove the water against fixed vanes which again repelled it, and thus about 50 h. p. was absorbed and the ropeway was rendered amenable in speed, with the control of a hand brake, being regulated to a nicety by adjustment on fixed vanes against which the water impinged. To keep the temperature of water employed in the brake sufficiently low a small supply of cold water was provided.

(4.) A single fixed rope on which one carrier is drawn to and fro

with an endless hauling rope, the driving gear having reversing motion so that the direction of travel of the carrier can be controlled. It is suitable for handling large quantities over short distances—viz., 400 tons in 10 hours—with terminals about 450 ft. apart. The ropeway on this principle located at Table Mountain is an important example of a line 5,280 ft. long. Commencing at sea level, and following the ground

THE TOP OF THE TABLE MOUNTAIN RAILWAY.
Showing the steep incline and beginning of 500-ft. span to first support. Bullivant & Co.



ANOTHER VIEW OF THE DUQUESNE ORE-HANDLING AND STORAGE PLANT.

AMERICAN CABLEWAYS AT WORK ON THE PANAMA CANAL.

The view is taken at Emperador, 32½ miles from the Atlantic, looking toward Colon.

on posts spaced about 300 feet apart, the cable takes a span of 1,500 feet, rising to a projecting rock some 1,480 feet above the starting point. Resting on a support at this point, the cable again takes a span of 1,400 feet to an upper terminal 2,200 feet above the lower one. This ropeway has worked so satisfactorily that it is not only used for the carriage of materials employed in the construction of a reservoir, but is at times used for the conveyance of passengers.

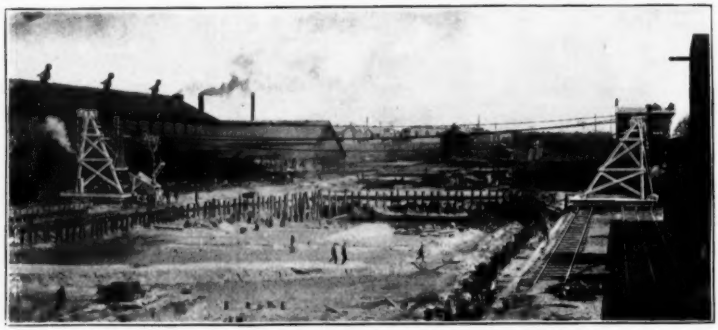
(5.) The use of two fixed ropes, with an endless hauling rope, in which one carrier travels in one direction, while the other runs on a parallel rope in the opposite direction. This is a thoroughly serviceable type of tramway capable of being used over extremely long spans, and of carrying loads up to five tons. This system is one which is in-

A PORTION OF THE WARWICKSHIRE ROPEWAY, SHOWING CARRIERS OF IRONSTONE IN TRANSIT.

termediate between the third and fourth, adopting the use of two parallel fixed ropes as in the third system, but with the use of one carrier on each rope as in the fourth system. It may be used where the quantities required to be moved are such as will admit of the ropeway being worked by gravity, one carrier descending loaded while the other carrier ascends unloaded. With this arrangement, long spans may be made without supports, loads up to 6 tons may be carried, and quantities up to 100 tons per day transported. In other cases steam power may be employed, and the loads moved from the lower to the upper terminal while the empty carrier descends loaded or unloaded as may be the case.

By the experience gained in the construction of a number of such ropeways, great efficiency has been arrived at, so much so that these ropeways may be relied upon to provide a safe means of transport for passengers, and the speed at which the carriers run can be very great, indeed not infrequently amounting to thirty to forty miles per hour. The control of the line is effected by a brake gear situated at the upper terminal, operated by one man who can perfectly regulate the speed.

(6.) The use of one fixed rope placed on an incline on which carriers, from which are suspended loads, are allowed to run down uncontrolled one at a time. This is generally called a "shoot." This system is simple, and used for the transport of undamageable goods. It consists of a light wire rope stretched between two points, the elevation of one being considerably above that of the other. On this, loads from 1 cwt. to 4 cwt. hanging from a runner carrying one or two



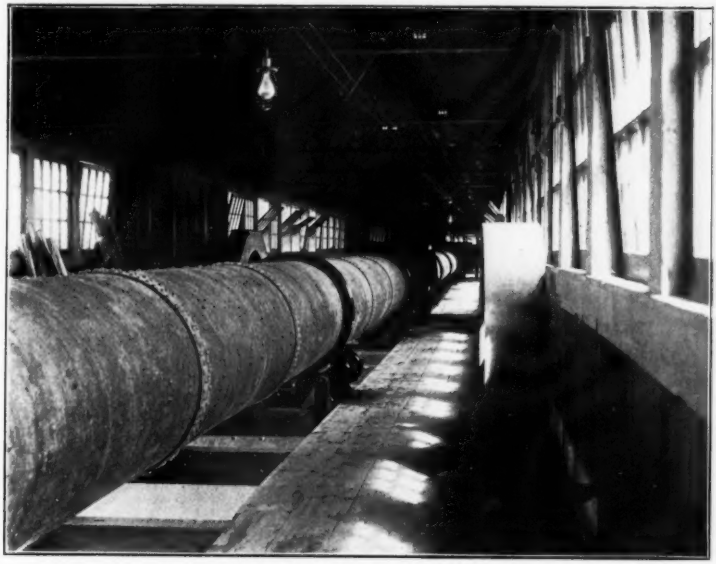
CABLEWAY AT WORK ON EXCAVATION FOR DRY DOCK AT NEWPORT NEWS.

The span is 275 ft., and the movable towers between which the cable is suspended are about 35 ft. high. Skips are filled by hand and discharged automatically. Lidgerwood Mfg. Co.

wheels, are allowed to run down uncontrolled. The shock can be lessened by regulating the sag of the rope where the levels of the ground will admit, so as to reduce the speed of the runner with its load as it approaches the lower terminal. This type of ropeway is largely used for the carriage of firewood, coffee, or other like materials. Spans can be made without support up to 7,000 feet, and all that is required for fixing the rope is a good anchorage at the upper end, and another with a tightening gear at the lower end. Ropes for this purpose up to 3,500 feet spans are used, made in the form of a strand; above this, in order to obtain the necessary strength with a moderate size of wire, ropes are used consisting of several strands formed each of several wires. The runners have wheels of small diameter, and are made as

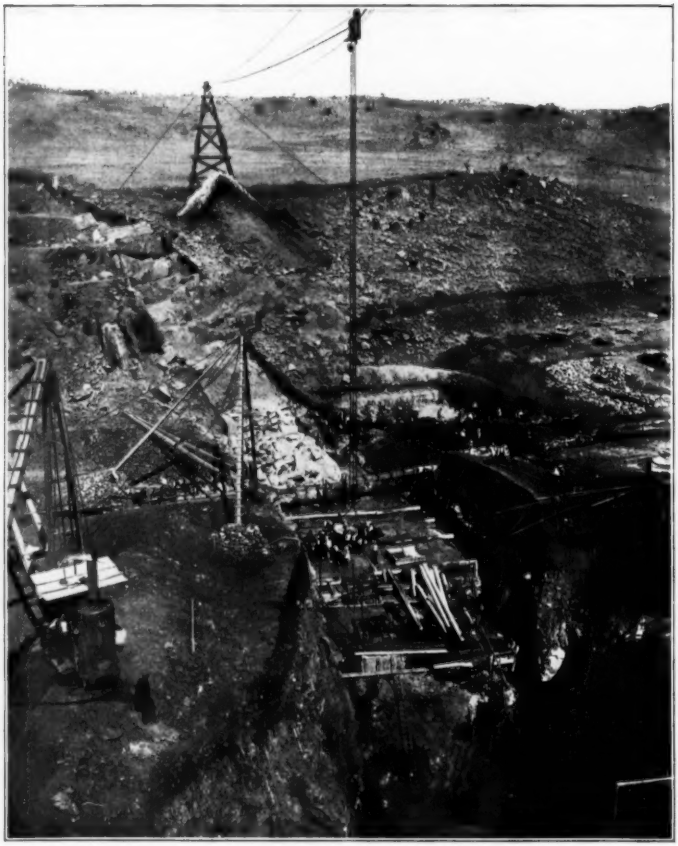
MECHANICAL TRANSPORT OF SPOIL IN DIGGING A WATER-POWER CANAL.

The heavy drag-rope at the bottom moves the loaded scoop; the upper endless ropes serve to set the scraper in position and to trip it when it reaches the spoil bank. Span, 725 ft.; face of excavator, 7 ft; worked by 75 h. p. engine. Lidgerwood Mfg. Co.



STEEL ROTARY CONVEYOR FOR CARRYING AND COOLING SODA, CEMENT, ETC.

A continuous spiral steel blade is attached to the inner surface of the cylinder, which is revolved by power-driven gearing placed on the outside. Link Belt Engineering Co.



BUILDING A DAM FOR THE CONSOLIDATED GOLD FIELDS OF SOUTH AFRICA.
Lidgerwood cableway used for excavation and for placing of masonry.

light as possible in order that, after 50 or 100 loads have been delivered, the empties may be returned for more material.

The applications of this system are too numerous to recite. They are dotted over Aberdeenshire as thick as the double-strand noria bucket pumps in use on the continent. Probably many hundreds of miles are in operation, and with a rope or strand of suitable material and strength, together with well made runners, the carriage of such material as can be treated in the manner named above is alike efficient, economical and speedy.

PROGRESS IN AUTOMOBILE CONSTRUCTION.

By W. Worby Beaumont.

WHEN I wrote on the horseless carriage industry, in THE ENGINEERING MAGAZINE for September, 1897, I remarked that "the motor-car industry in Europe to-day affords a remarkable illustration of the great distance or difference there may be, and usually is, between a 'good makeshift' and a thing which is so far on the road to practical perfection that possible improvement is not obvious on inspection. In the motor-car the difference has been, and is, chiefly in mechanical imperfection."

During the two years which have passed since then the essential lines of construction have received no radical change. In such highly successful vehicles as those of Panhard & Levassor, of Peugeot Frères, and of Benz, two years have not pointed the way to any necessity for such change; but they have been marked by very great strides in the removal of mechanical imperfections. The memorable feats of the vehicles of Panhard & Levassor, of Peugeot, and of Mors in the Paris-Amsterdam race of last year, the Paris-Bordeaux race of this summer, and the Tour de France race, have been accomplished by the removal of mechanical defects shown by previous similar severe tests, by the adoption of higher and higher grade materials, by the adoption of methods and workmanship previously looked upon as too expensive for anything but standard tool-making, and by a minute attention to every indication of experience and every means of convenience.

A moderate, and even a large, increase in power does not necessarily mean anything like a proportionate increase in weight. Hence, very few of these new carriages are fitted with the small powers common in 1896-7, and for the faster vehicles four-cylinder motors of the Daimler type are used. They are fitted so that one, two, three, or four cylinders may be brought into play, and even these are made to run through a greater range of speed than was generally possible two years ago, the greater range being secured by more perfect carburation and admixture of the richly carburetted air and the supplementary

pure-air admission and by the use of higher compression. Thus, with a wider range of speed in the engine itself, and with the permissive action of one or two pistons of a two-cylinder engine, or of one to four pistons of a four-cylinder engine, a degree of flexibility has been attained which, in the hands of an experienced driver, approximates that of a steam engine.

This change has modified the damaging effects on the spur gearing which were difficult to avoid when each change of speed was generally accompanied by heavy impact as well as by sudden increase of spur-tooth load. The spur wheels, or rings carrying the teeth, are made with great accuracy, of higher-grade material, and are hardened; and every bearing of a crankshaft is not only hardened but accurately finished by emery grinders to take out every trace of the frequent effects of hardening. Now that it has become obvious that the motor-car has come to stay, the experienced mechanical engineer has come to the aid of the less experienced originator, and the high prices which the wealthy sportsmen of Europe are willing to pay for the best car have justified the best that can be used and that skill and experience can suggest.

More cylinders are used with less trouble than is involved in the use of more gear, and the demand for more power is answered by the admission that its provision is easy at a price, and that, the motor being provided, power is cheaper than most things.

The permissive use of one or more of the two or four pistons does not affect the governing, and the control of the governor itself, so that it may go into operation at different speeds or be cut out for the greatest acceleration, is effected by simple and convenient means.

This increase of power has been attended by comparatively small increase in the total weight of vehicle, and, in some of those which were more open to improvement, by no increase per seat provided. The employment of steel and of stamped forgings, in place of heavier castings, has helped in this, and the improvement in the constant-circulation water-jacket coolers has reduced the weight of water which formerly had to be carried. In some recent cases, by the use of light tubular coolers with the supply tank placed so that natural circulation can be used, the weight has been reduced over a hundredweight and the necessity for a pump avoided.

In the more recent carriages the objectionable smell from bad exhaust has been avoided by the means already mentioned for varying the quantity and place of admission of air (some of which may be warmed before admission) and by greater compression. The latter has been made possible by simple means adopted for holding open the

exhaust valve during part of the compression stroke while starting the engine, the cam automatically returning to its normal place after the engine has started.

The higher speeds and the long distance runs over all sorts of roads against time have not developed the power side of the motor carriage alone. High propelling power demands high transmission power, beginning with the gearing, to which I have referred, and ending at the tires of the driving wheels. Here the limit of endurance of materials, employed in the best ways at present known, is soon reached—or so soon as to present one of the most troublesome problems for the motor-carriage maker and user. That spring wheel is best which puts the spring nearest to the point of incidence of the impact from which we want to shield the whole of the motor-carriage. The most perfect spring we can have is air under pressure, and a pneumatic tire is the best way yet known of putting that spring into use. Its use means a deformable envelope, which must be well and strongly made, capable of withstanding not only repeated deformation at high speeds, but under the worst possible conditions as to wear-and-tear by the cutting and abrading irregularities which effect the worst of the deformation under an insistent load. The envelope, moreover, must be easily detached and replaced, and capable of withstanding high tangential tensile stresses as well as the continuous stress due to an internal pressure of 50 to 80 lbs. per square inch. This very difficult problem has not been solved, though it has been met with considerable success by Michelin, in France, where the high-grade high-speed car has most persistently proved the speed superiority of the pneumatic tire over any other. In England the same success has not yet been achieved, but tires of the same form and method of manufacture are now being made. On this question it does not appear to be recognized, that, even with rubber, there is a limit to velocity of transmission of impact, and therefore a limit to the velocity of impact under which rubber will bend, or extend, and not break. The higher the speed, therefore, the greater the effect of road abrasion and the more frequent the conversion of an abrading stone into a cutting stone. Thus, the limit of endurance of the materials puts a limit upon both the speed and the weight carried, and the past year has probably seen the limit of endurance approached by the distinctive co-action of high speed and heavy weight. On the other hand, the same period of time has shown how highly enduring the same tires may be when only one of the two destroying causes is in action. Many of the motor tricycles have run thousands of miles at speeds which are second only

to those of the fast racing cars, but instead of having a load of about 0.25 ton to 0.3 ton per wheel, their load is only about 0.07 ton per wheel, or, say, one-fourth of the load on a full sized racing car—enough to make all the difference between play and punishment. The attempt to use solid rubber tires for vehicles of heavy weight and high speed has also brought about numerous interesting experiments during the past two years. Some of the most thorough and most practical have been those of the Lifer company, which, with a steam wagonette weighing under 39 cwt. empty and 54 cwt. with fuel and water, has been running thousands of miles with from ten to fourteen passengers at speeds up to 30 miles an hour. With the best tires that can be got, about 3¼ in. wide between the turned-in flanges of the rim, a pair of tires will only last about 2,000 miles. At an average speed of 8 miles an hour instead of about 12, these same tires would probably last another 400 or 500 miles, and if they were endless and vulcanised on the metal rim they would probably run at least another 500 miles. With a weight of, say, 2 tons instead of 3½ tons, or 10 cwt. per wheel instead of 18 cwt., these same tires would probably have a life of over 4,000 miles.

The past two years have done much to put the mineral spirit (or petrol) motor vehicle at the head of all long-distance high-speed and high-endurance vehicles. The motors themselves, as already mentioned, have received many developing touches, and the greater convenience attending the use of petrol, as against kerosene, has not been in the least diminished. Attempts have been made in France to put on the roads a heavy-oil vehicle, but, inasmuch as the very soul of a kerosene motor is its vapouriser and feed and vapour-valve arrangement, that which was tried was doomed to failure for the variable work of an automobile.

In England Messrs. Roots & Venables stick to kerosene and have sent a few cars to hot countries, but their efforts have not been encouraged by the flattery of imitation. There can be no doubt that the oil of high flashing point has strong recommendations for countries so hot that gasoline is a continual source of danger or is unattainable, or for trading vehicles in which the lower cost of kerosene is a matter of importance; but for all light and pleasure vehicles. gasoline is, at present, much to be preferred on account of the greater cleanliness, the more perfect combustion and the easy control of vapourisation, the freedom from cylinder and piston troubles, and the greater control on the character of the exhaust on very variable work and stop-and-start repetitions of town work. It is, however, still con-

ceivable that a feed of minute accuracy and a gasifying vapouriser with gas receiver and valve-controlled admission to cylinder may yet be made which, under all ordinary exigencies of interrupted working, will make the use of kerosene sufficiently unobjectionable.

In Europe the past two years have seen very little of development of the steam carriage. Most of that time M. Serpollet, to whom all turn in expectation, has been too much occupied in the completion of the Serpollet tram cars of Paris. That being accomplished, he has now returned to the steam road carriage and in conjunction with M. Gardner is building a large number of the carriages of his most recent form, similar to those exhibited in the Automobile exhibition in Paris last summer, and in London in July. He is now using a small spiral-tube Serpollet generator and a motor with mushroom valves, operated by cams on a shaft which can be moved laterally, so that cams for either direction of rotation can be brought into action at will for reversing, the motor being very simple in construction. These carriages have not, however, taken part in any of the recent contests and their power and endurance remain in this sense to be proved.

In England the successful steam vehicles are of a heavier kind, such as the wagonette referred to already and a much lighter vehicle on the same principle and lines by the Lifer company—*i. e.*, the Liquid Fuel Engineering Company. The boiler used by this firm consists of series of rings of closely packed vertical tubes, slightly bent to give them all about as much spiral bend as the grooves in a large rifled gun, the lower ends of the tubes being fastened by unions, below the level of the hot flame from the powerful kerosene burner employed, into an annular water chamber. The upper ends of the annular forest of tubes are bent and fastened by unions radially in a vertical, cylindrical, water and steam vessel. This boiler gives excellent practical results, and gives dry steam to the small horizontal double-cylinder compound reversing engines which are carried in a complete underframe separate from the car body, the whole drive being by spur gear. Chains have been discarded, more particularly for the heavier wagonettes. The same firm has achieved much practical success with heavy trading lorries and vans, as used by brewers and others. Other firms, including the Steam Van and Wagon Co., have achieved success with the heavy classes of vans and lorries on the Thorneycroft system, the weight being not more than 3 tons unladen and without fuel and water. These vans carry as much as 4 and 5 tons, and in trials under the Automobile Club at Richmond, and by its Liverpool branch on roads surrounding Liverpool, they behaved this year with great suc-

cess. Both the Lifer and the Thorneycroft were subjects of trial during the meeting of the British Association for the Advancement of Science at Dover last September, when, as at Richmond, the author was one of the judges. With loads of 3, 4, and 5 tons, these vehicles made excellent runs on roads of varied character and considerable grades, one man manipulating them with marvellous facility.

Another sign of the times was the two heavy-load lorries exhibited at the Richmond show and tested by the Automobile Club last June. These were made by the Cannstadt Daimler Co., one fitted with 6-h.p. and the other with 10-h.p. petrol motor. One carried 3 tons and the other 5 tons. They went through the trials in admirable style and were manipulated in and out of yards and sheds with at least as much facility as the steam cars. They were operated by one man, while some steam vehicles require two, and the cost per ton-mile of load carried for the oil used as fuel was only 0.33d., while the water required was nominal.

A great deal has been done in the two years in the development of the electric vehicle of various types, and the result of the two years' work seems to be that, for town work and short radius runs, they are satisfactory and pleasing as to smoothness and quietness of running. They meet the requirements of those who do not wish to run more than 25 to 30 miles per day, of runabout work, and of those who do not study the cost either of vehicle or of running or maintenance. The secondary battery is still a thing of delicacy, which can soon be ruined by inconsiderate drivers who would use a starting switch as they would use a steam valve, and it is also a thing which is far more durable as a fixture than when used even in the most comfortably sprung automobile. As cabs, the electromobiles have failed in London; they are in a similar plight in Paris, and at present none of these electric vehicles appears likely to take the place of horse vehicles in commercial work.

Another sign of the times is the fact that, although a number of automobile sportsmen have ordered racing cars of high power from some English makers of gasoline-motor carriages, at least one admirer of the steam engine for such purposes has failed to get, from the most esteemed builders in England, a tender for a steam carriage of similar power. The Daimler motor may be said to hold the field, and some indication of the similar state of things in France and Germany is the fact that the Panhard & Levassor Co. have on hand now orders for over £600,000 worth of carriages, and both the Cannstadt and the Benz companies are building cars to seat two or four, with

motors of from 16 to 24 h. p. for fast running and high-speed hill work, and all makers have more than they can do.

A departure from the general lines of automobile-carriage construction which is very popular has marked this year's output of many builders—namely, a smaller vehicle to carry two persons and fitted with a 4-h. p. or a 6-h. p. motor. MM. Peugeot Freres, MM. de Dion & Bouton, M. Decauville, MM. Daracy & Bollée, and several others on the continent and in England are making these cars and find a large demand at about £200. Many of them are fitted with the still smaller motors of the de Dion type, used for the more powerful tricycles, but the Peugeot and the de Dion two-seated voiturettes have larger motors with water-jacketted cylinders.

The development of the electric two-seated victoria and other carriages in the United States has attracted much attention in England, but at present the vehicles capable of long distances with a few pints of oil occupy the most attention, and charging stations are not numerous yet, and, even when they are, charging takes a long time.

The light steam cars of Whitney and of Stanley have also attracted much attention, but the benzoline used as fuel is very costly and not quite so harmless as when used in the internal-combustion motor, which requires so very much less water, or none at all. The boiler, like the other parts of these cars, is a highly meritorious and high-bred kind of thing, requiring, perhaps, more attention than it is likely to get willingly in Europe, where, at the end of a hundred mile run, the car is likely to have no more attention than to have its lamps put out, the oil and lubrication stopped, and then to be allowed to remain until the morning. This would not suit a boiler with tubes ⅛ of an inch apart which had been running all day on chalk-district water. These carriages are, however, at present so light in total weight that boiler and everything else could be increased in size, weight, and strength and still be able to run fast on pneumatic tires.

Lastly, as evidence of the growth and importance of automobilism, I may mention that the Automobile Club of France has nearly two thousand members, and the subscription is £8 per year; the Automobile Club of Great Britain has now nearly six hundred members, and active automobile clubs have been formed in Germany, Austria, Italy, Belgium and elsewhere.

The big company-promoting business is practically dead, and those companies which are formed now have nearly all their capital as working capital.

THE REVOLUTION IN MACHINE-SHOP PRACTICE.

IV.—THE LIMITATIONS OF TOOL-MAKING.

By Henry Roland.

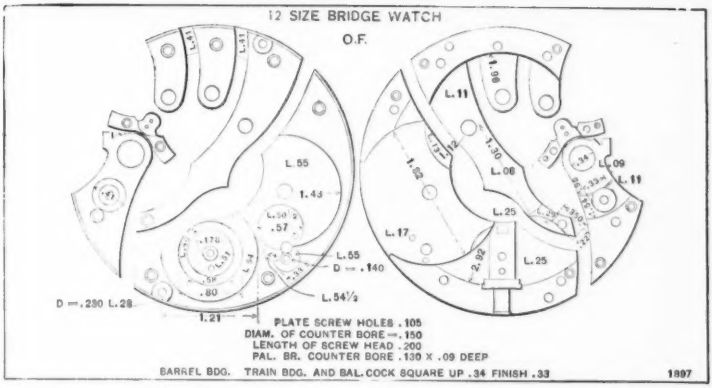
IT has been clearly shown that if the human race continues to exist and to advance in morals, comfort, and elegance of living, tool-making must begin and must be carried to what now appears to be a high development. What is the limit of the tool-maker's art, and when and where should or must tool-making stop?

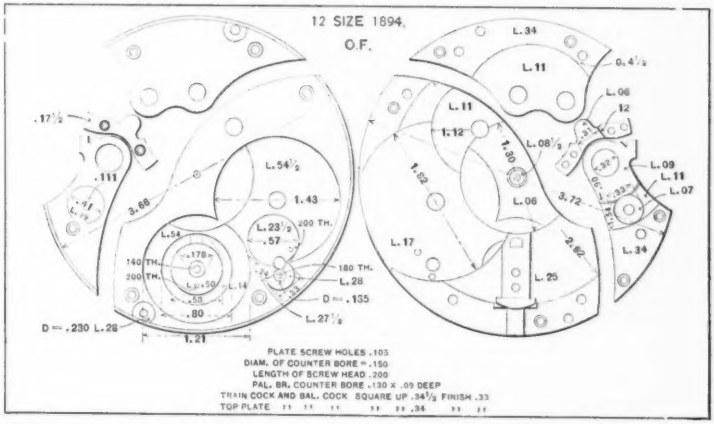
Commercially speaking, it must stop in any particular case when more tool-making cannot cheapen the total time cost of production; if the demand for the product is unlimited, then the only limitation in tool-making is the limit of human understanding and mechanical resources. When the tool-maker cannot further improve the quality or lower the cost of the product, then, very clearly, the end of his usefulness in the particular case has come.

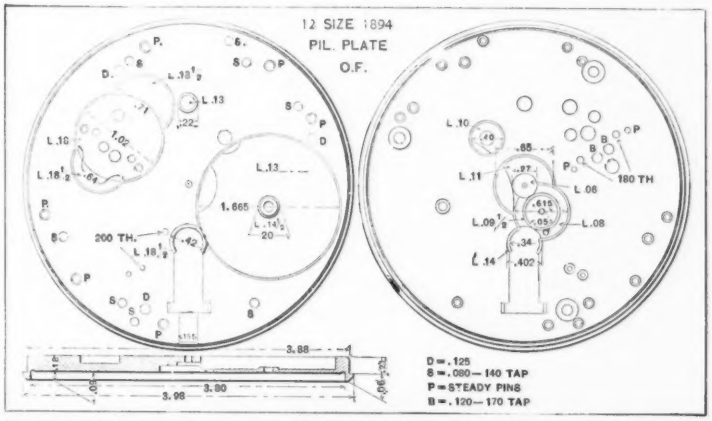
If the demand for the product is limited, and cannot be enlarged by bettering the product and reducing its selling price, then there is a total remuneration to consider, and the limited total remuneration must limit production expenditures, tool-making included.

Broadly speaking, it is conceivable that in some special production tool-making may be carried to a point where no farther profitable advance can be made, and it is also conceivable that there may be things useful and desirable to the few, which cannot by improvement of quality and lowering of cost be made useful and desirable to the many; but it is extremely difficult to select examples illustrating either of these propositions. Speaking narrowly from existing facts and conditions, it seems probable that the limit of tool-making has never been reached in any particular case.

Suppose an article to be produced wholly by automatic machines, so that its cost does not include any direct labor. It was Spencer's custom, when he first set a few of his double automatic screw machines at work making screws from large coils of wire, to lock up the room and go away and leave the machines wholly unattended for a considerable period of time, perhaps almost as long as the stock would last, and it was the rule for him to find all of the machines still at work when he again unlocked his factory door. Here is an actual case where labor





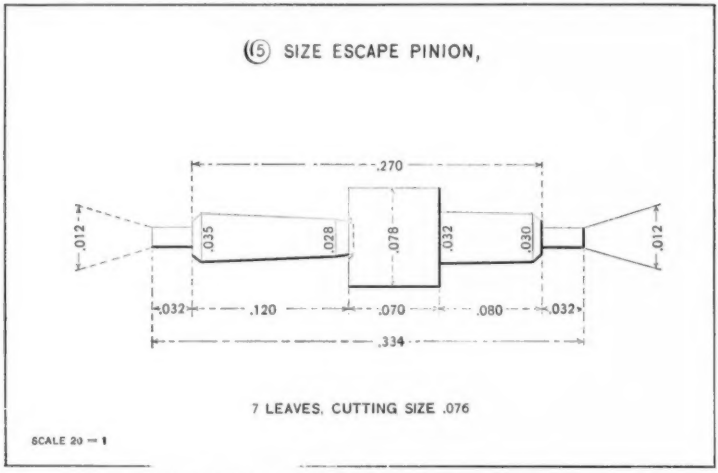


THE LOWER TWO CUTS SHOW "12 SIZE PILLAR PLATE" AND THE BRIDGES AND COCKS CONSTITUTING THE TOP PLATE OF A MACHINE-MADE WALTHAM WATCH. THE UPPER CUT SHOWS A TOP PLATE OF MORE OPEN ARRANGEMENT. ALL ARE MADE ENTIRELY BY THE AUTOMATIC MACHINERY DESCRIBED IN THIS ARTICLE. DIMENSIONS ARE IN DECIMAL FRACTIONS OF A CENTIMETER.

cost was wholly eliminated, but this does not stop tool-making in that direction. No automatic tool is so good that it may not be bettered, and a machine which seems a miracle of perfection to a casual observer may be well known by its builder to be susceptible of great improvements. All cases of tool-making seem to fall into the common conclusion that, since perfection is beyond finite powers, tool-making can never end even in one particular case.

In practice, tool-making does end, as a rule, when the production cost is lowered below that of competing makers; but if the competitor improves his tools and lowers the previous lowest production cost, then others must do more tool-making or fall behind the trade.

In the case of unlimited demand and open competition in production, which is the general case of manufactures at large, tool-making may be carried to any extent. As an example testifying to the truth of this proposition, this paper will be devoted to an exhibition of the various tools which have been devised for drilling the little holes in watch plates—the plates of a watch being the two circular flat metal pieces, separated by short posts, which support the machinery of the watch, or one single completely circular plate supporting the various bridges and cocks which take the place of the second full plate. It may be said here that, broadly speaking, there is no other thing in common use farther from being an essential feature of human exist-



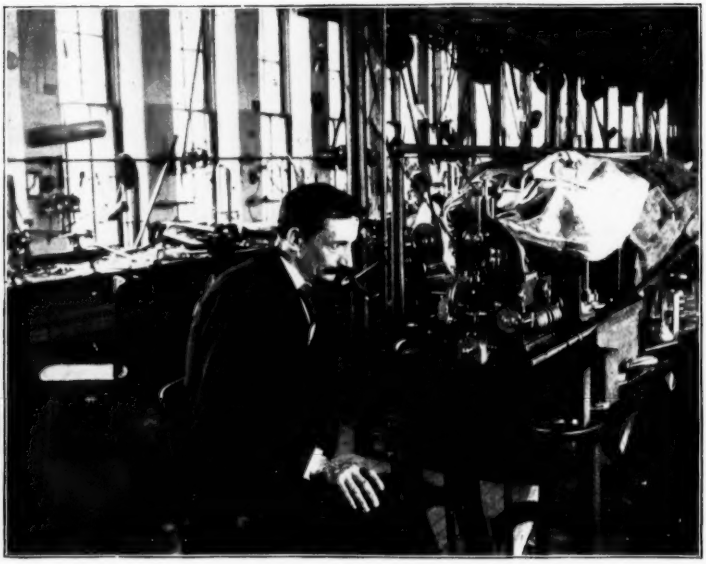
WALTHAM MACHINE-MADE ESCAPE PINION. SCALE, 20 = 1.
Dimensions are in decimals of a millimeter.

FRONT AND BACK OF TWO PATTERNS OF "12 SIZE" WALTHAM WATCH PLATES.
ACTUAL SIZE

The plates, as photographed above, are made complete from punched blanks, drilled and tapped wholly by automatic machines, and bear no hand work whatever.
The plates above were assembled at random from finished parts.
In this condition they cost about 8 cents apiece.

ence and comfortable living than is a watch. Yet, solely through the efforts of the tool-maker, the watch has become one of the first necessities of civilization, the demand is unlimited, the trade must always be in the hands of those makers who have the best tool-makers, and the watch parts are so small that automatic machines of every sort may possibly be applied to their production. Hence the watch-tool making does, as might be expected, furnish the most advanced examples of the tool-maker's art.

Holes are made in the watch plate and bridges and cocks, and these holes locate the various parts of the watch machinery and sustain them in fixed relations with one another. It is obvious, on a moment's reflection, that these watch-plate holes must be alike in location in each watch of a certain pattern, otherwise the watch parts will not be similarly placed with regard to one another, hence cannot similarly affect one another, and consequently the watches will not be uniform in action. The first watch plates were, of course, drilled with holes located by the hand of the workman; having produced one satisfactory



DUANE H. CHURCH.

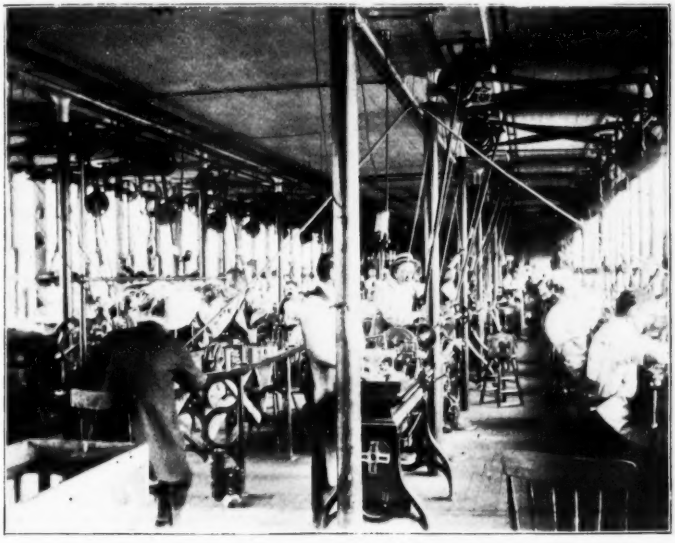
The picture was taken without his knowledge, as he was intently watching a new automatic serial numbering machine for numbering watch plates in sequence.

watch by hand operations, the next step in advance was to duplicate this by the use of machinery, as it is impossible to lay out and drill two watch plates exactly alike by hand.

The most natural and obvious expedient for locating several holes in the same relation to each other in different pieces of metal is what is known among tool makers as the "jig." The jig for drilling holes is a metal structure having two essential elements of precision; first, it must hold the pieces to be drilled in a fixed and unchanging relation to itself, and second, it must be pierced with holes whose centres correspond accurately with the centres of the holes which are to be produced in the work. The holes in the jig may be the same size as the holes to be made in the work, or they may be larger than those holes, and these large jig holes may be used to take short cylindrical or cone-shaped pieces of hardened steel, called "bushes," the bushes being pierced with holes as large as, or larger than, the holes to be produced through their use. Each drill to be used with a jig must have a part of its body to fit a jig hole or bush, and a drilling jig is used by clamping the jig and the work together, and then passing a drill, guided by

a jig hole, through the work. As the drill must be free to turn in the jig or jig bush, or else the jig bush must turn in the body of the jig to permit the drill to rotate, it is evident that there must be some degree of clearance between the drill and its guide, and this clearance is the first element of uncertainty in jig drilling. Again, there is great friction between the jig and the drill body, which soon makes the drill loose in the jig, and so makes inaccurate work possible. The jig is, however, very largely used in drilling both heavy and light work, and the watch-plate holes at the American Waltham factory were all drilled through jigs up to the time when Mr. Duane H. Church began his direction of methods and means of metal working at these shops in 1890.

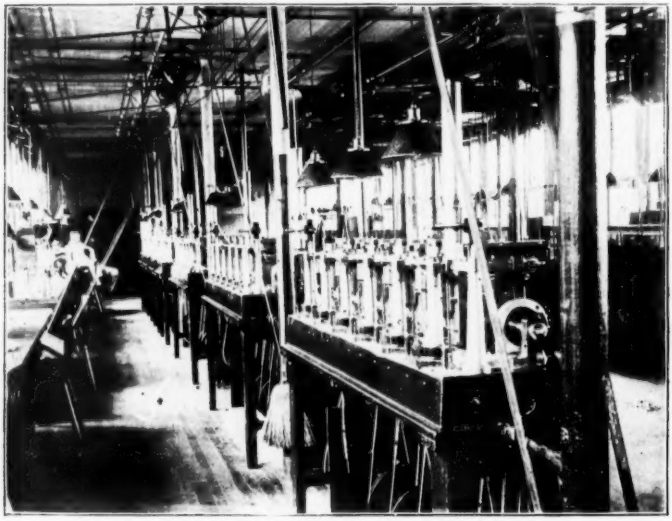
It may be said, probably without dispute, that the Waltham watch shops have gained their superior position mainly through the clear previsions and wonderful mechanical resources of Church, all of whose work is patented, and so, though freely exhibited to rivals, not open to their use. But, if there were no patents in the way, imitators and followers in matters of tool-making are hampered by time limitations which cannot be evaded, so that it is, perhaps, impossible for copyists to be nearer than, say, ten years behind the successful origi-



GENERAL VIEW OF ONE WING OF TOOL-MAKERS' SHOP, WALTHAM WATCH WORKS.

nator of new methods and tools used in machine part finishing, where, as in the work of Church, absolutely new methods and effects of the highest advantage have been devised and carried into wholly successful operation.

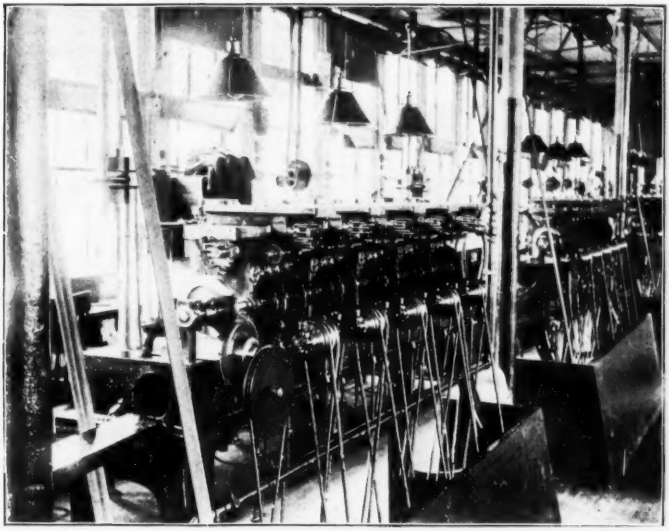
Duane H. Church was born in Madison County, New York State, in 1849, and at the age of sixteen began his apprenticeship as a watch maker under the instruction of J. E. Gridley, of St. Paul, Minnesota, whose constant admonition to the young mechanic was "Never leave a piece of work until you have done the best you can do"; Church said



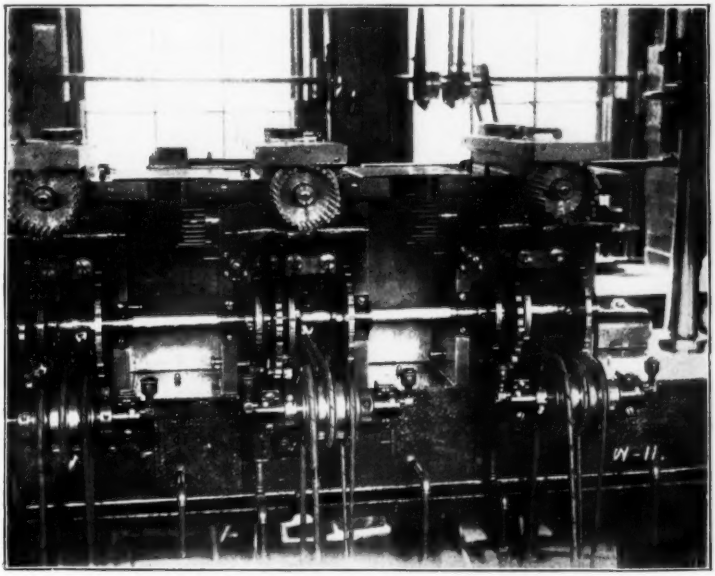
FRONT VIEW OF PLATE-DRILLING AND TAPPING MACHINES.

Transfer arms in front; three 6-head and four 2-head machines. There are in the factory altogether fourteen machines, doing the work for 2,500 watch movements per day, handling 12,500 separate pieces and performing about 405,000 operations. The attendant is seen in the extreme rear.

that he believed his own success was largely due to having this injunction so often repeated to him by Gridley, who was most conscientious and highly successful in his vocation. The words may have furnished a formula expressive of the dominating motive of his work, but even a slight familiarity with what he has done is quite sufficient to convince the observer that Church could not possibly construct a new tool which was not very much superior, both in general conception and in details, to all that had gone before. After completing his work under Gridley's instruction, Church worked for seventeen years as a watch maker



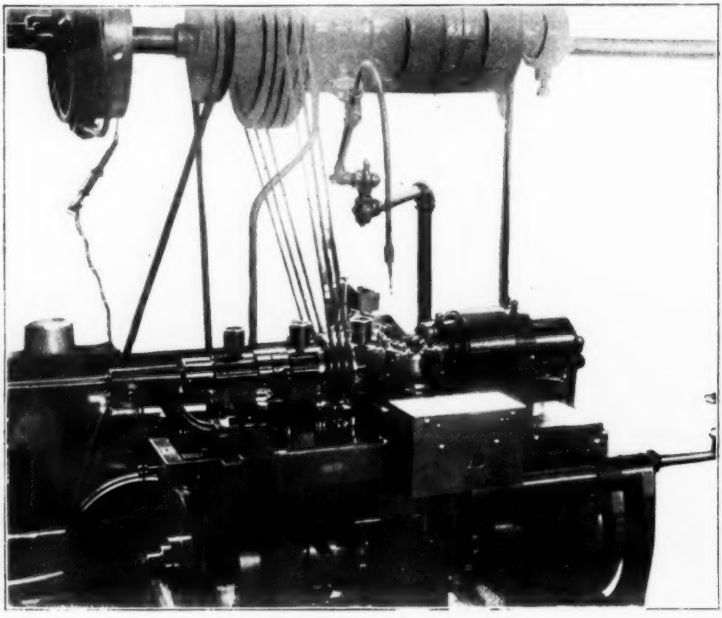
LEFT REAR VIEW OF PLATE-DRILLING MACHINES.



A PART OF THE REAR OF THE PLATE-DRILLING MACHINES.

Showing the stops for stopping the plate holder in two directions, at right angles, so that a hole may be correctly located at any point in the plate. Shows also the cams operating the air-admission cocks, and the two-speed countershafts.

at the bench, principally for Matson, of Chicago, and for St. Paul establishments, all of this time giving no hint of his latent powers as a tool-maker, though he was accounted one of the best of watch repairers; finally he attracted the attention of the officers of the Waltham company, which at that time needed the best watch makers obtainable, and entered its service, first traveling one month on the road in "missionary" effort, asserting machine-made watches to be superior to all others—a proposition much more nearly true now than it was then. Next he was for another month in the Boston office of the company on

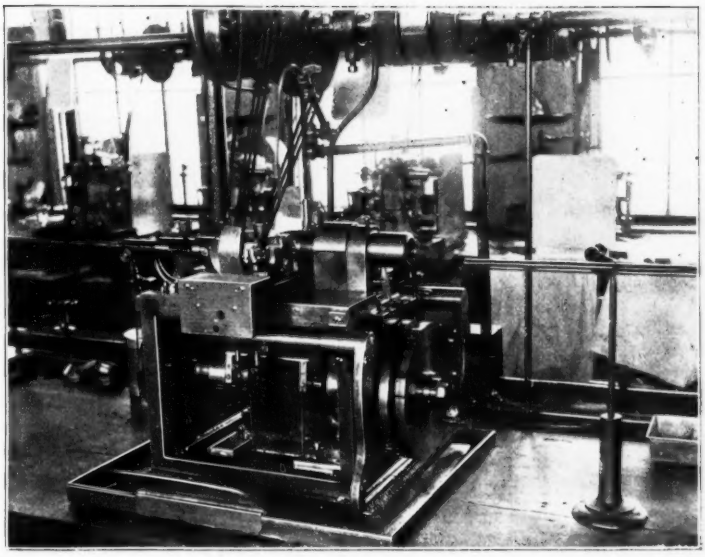


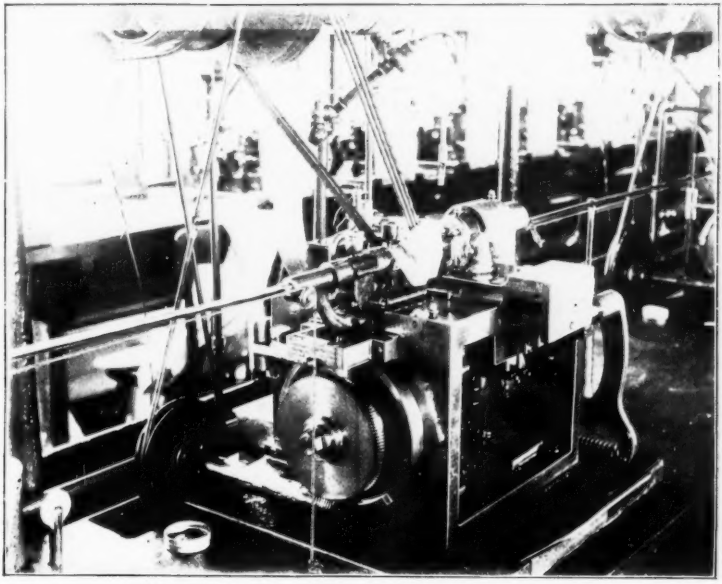
FRONT VIEW OF BALANCE-STAFF LATHE.

Makes a complete balance-staff as shown in the engraving on page 543.

experimental work, and finally, in 1882, reached the factory and at once took the position of master watch maker, which he held for eight years, during which he greatly improved the general design of the watch movements and devised the highly important form of pendant setting watch which enables stem-winding movements to be placed in cases not specially fitted to them—the most valuable feature, commercially, ever applied to watch construction.

Finally, after twenty-five years of intimate association with watch





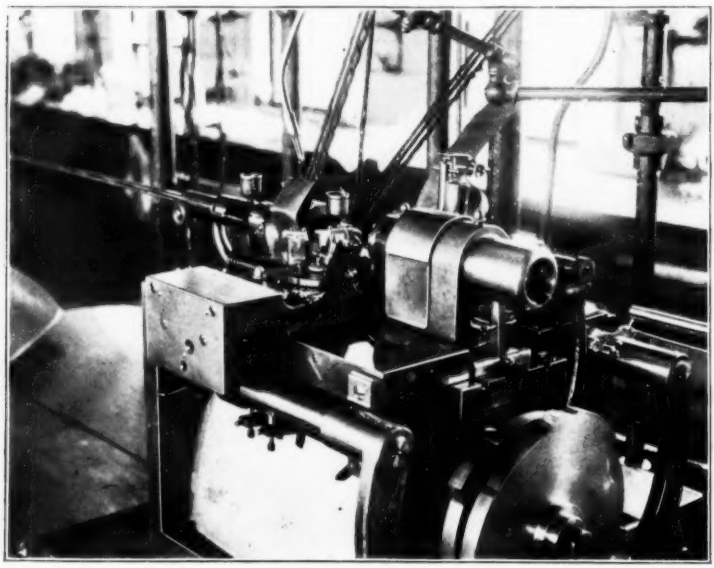
TWO VIEWS OF THE FRONT OF THE BALANCE-STAFF LATHE.
The lathe has two turret heads, each carrying four tools.

making in all of its forms, Church began his great work of advancing the use of Maudslay's slide rest and Stone's turret to what is now by far the most exalted plane of development known, and giving those elements powers which appear impossible of farther advancement.

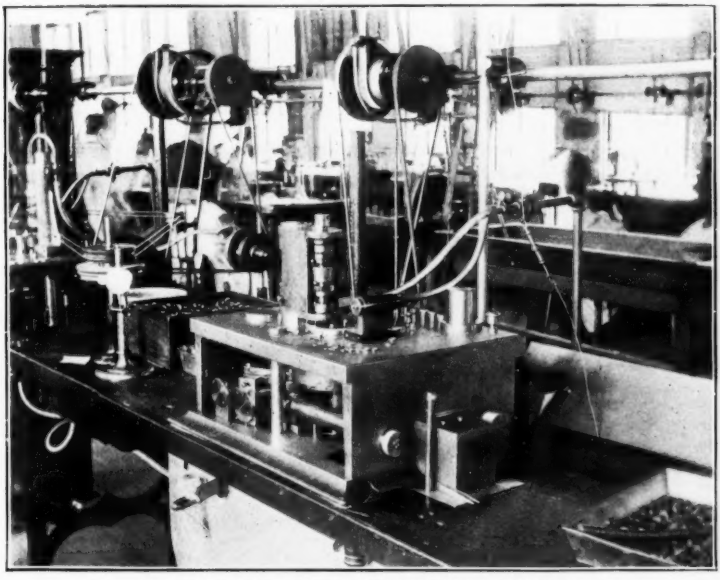
Some of his machines are shown in the illustrations given herewith, these tools being full automatics, and in all instances completing the piece produced before letting it go, no matter how many or how complicated the operations to be performed.

Church added to the slide rest and turret two new elements—first, that of compressed-air-driven piston-and-cylinder actuation of his automatic-machine members, and, second, a perfectly exact series of transfer elements, having the power to take a piece of work from one machine and place it accurately in another machine, with a beauty of action and precision of effect which seem to the experienced observer, when he sees these automatic machines in operation for the first time, to fall very little short of the miraculous.

In addition to the pneumatic and transfer elements, Church originated an automatic grinding machine, which produces cylinders and cones with absolutely no measurable variation in dimensions, wholly



REAR VIEW OF BALANCE-STAFF LATHE.



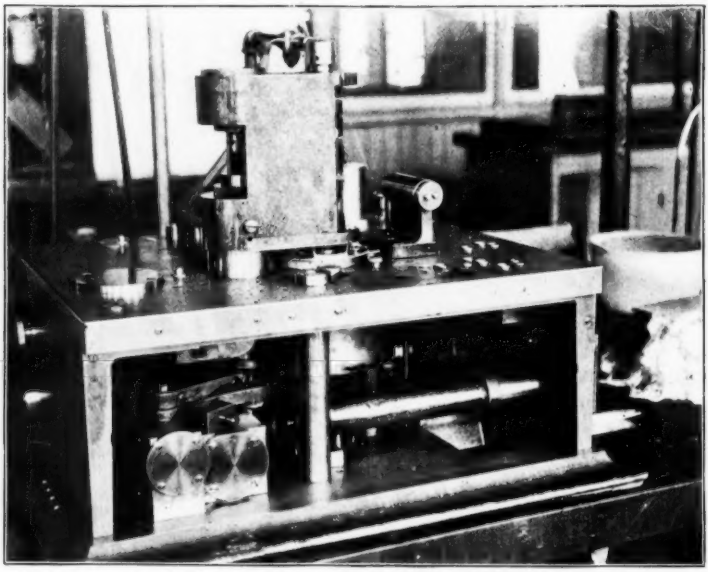
RIGHT FRONT VIEW OF AUTOMATIC GRINDING MACHINE.

Fully automatic; will grind any desired number of separate surfaces on one piece at one setting. The work is absolute in dimensions.

without human intervention, and at a saving of at least three-quarters of the cost of producing ground work under manual attendance. The production of cylinders of uniform diameter is an indispensable necessity of the highest development of tool-making, and this automatic grinding machine seems to me to have made one of the most wonderful advances in the whole history of tool-making. The possibilities of the machine are as yet almost wholly unknown to the world of mechanics, and apparently equally unappreciated, the tools not being in use anywhere outside of the Waltham shops, although the inventor is perfectly willing they should go into authorized general use. Space does not permit a full description of the machine. It may be said that the use of the grinding-wheel periphery as the effective abrading surface is wholly abandoned, grinding rings being used in place of grinding wheels, and that the grinding ring is advanced toward the axis of the work in process of grinding until its working surface touches a diamond, when the machine draws the ring back, removes the ground piece of work from the machine, places another piece in position, and

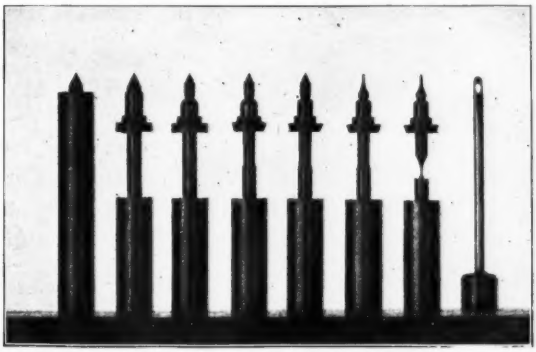
starts the ring to grinding it. This machine is adapted to be used on work of any ordinary size, and can produce true cylinders and cones at far less cost than anything else known.

When Church took the position of superintendent of tool-makers at the Waltham factory, the theory of step-by-step production was in force. There were roughing cuts and finishing cuts on the same piece, made in different machines and involving separate handlings. Church had become fully convinced that the cheapest and best method of machine-part finishing was formulated in Gridley's admonition



LEFT FRONT VIEW OF AUTOMATIC GRINDING MACHINE.
Showing actuating air cylinders in the body of the machine.

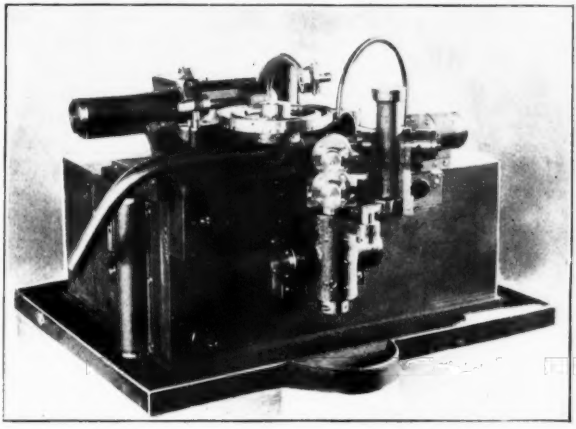
"Never leave a piece of work until the best possible effect has been gained"—that is to say, once a piece is in the grasp of an automatic machine it should not be released until fully completed. In the ten years during which Church has been in charge of the Waltham tool-making he has succeeded in carrying out this conception of complete production with only one handling in the making of many of the watch parts, the plate-drilling machines being the most impressive of all of his creations, because they are the largest, and the superlative accuracy of their transfer movements is plainly observable. When he



ENLARGED VIEW OF BALANCE STAFF AT SUCCESSIVE STAGES OF PRODUCTION.

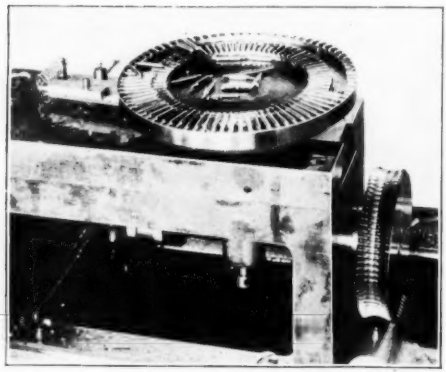
The stages advance from the left. The figure on the extreme right is a sewing needle of the smallest size usually sold, affording a ready means of size comparison. Pivots can be made as small as 2½-1000 in. diameter. No back rest nor other support is used in staff turning. The cuts are made with white diamond tools, ground to proper cutting-edge form.

took the plate drilling in hand it was done through jigs handled by girls, each girl having a drilling machine with three vertical spindles carried in one head, each spindle rotating a different tool, and having an independent feed motion. Each girl drilled in a watch plate all the holes of the sizes produced by the three drill spindles of her machine;



DRILL-MAKING MACHINE. CAPACITY, 1,500–2,000 DRILLS A DAY.

Drills are made so cheaply by this machine that it is cheaper to replace than to sharpen a dulled drill. The drills are shaped from tempered-steel blanks, drawn to correct diameter by grinding, and are ready to use as they come from the machine.



AUTOMATIC DEAD-CENTER LATHE, SHOWING FEEDER PLATE.

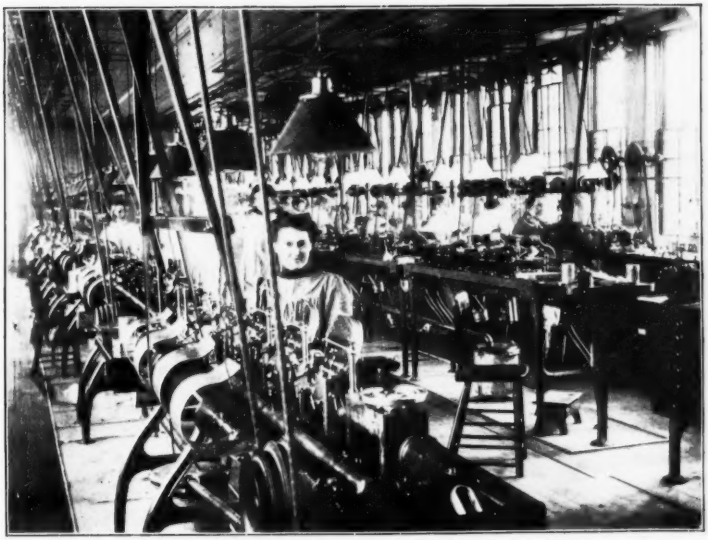
Except in the staking-machines, which are hand fed, all work is placed in the machines automatically, being fed from hand-filled magazines, tubes, or feeder plates, from which the machine takes one piece at a time to be operated upon.

then the plate was taken out of the jig and passed on to the next operator, who placed it in another jig and went on to drill the holes of the sizes produced on the machine under her charge. In spite of the utmost care possible, this step-by-step production produced imperfect plate drilling and made trouble without end.

Church had a clear conviction that there should be no jig work, which means that all holes must be located by the axis of rotation of the drill spindle, the drill itself having no surrounding exterior guiding surface, and hence that, for each hole, the plate must be brought to exact position in relation to the drill-spindle axis; if the plate could be held, say, horizontally over a rising drill spindle or cutter spindle, then the desired operation could be properly located in the plate. There are about one hundred and sixty different operations to be performed on a full plate; each vertical spindle head could conveniently carry as many as six spindles, and it was clearly possible to place as many heads, each carrying six tool spindles, as were needful, on one long frame, and provide

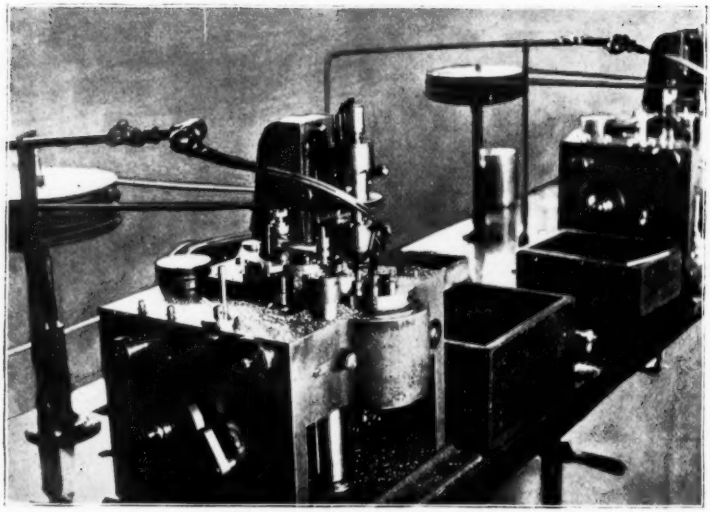
TESTING HARDENED WORK.

Truth of soft work is assured by methods of production. Hardened work is tested by being placed on double live centers and observed with a magnifying glass. The illustration is from a bank of five testing lathes, each operated by a girl inspector.



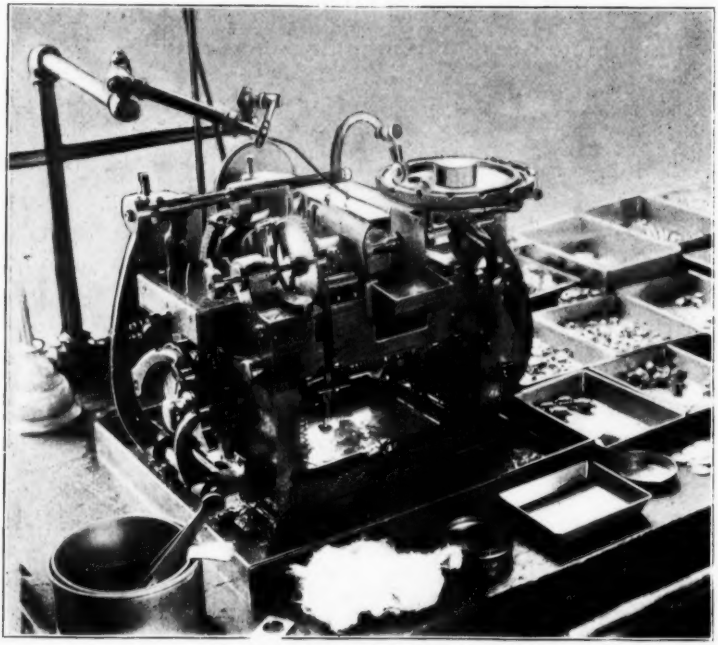
FRONT AND REAR VIEWS OF BANK OF AUTOMATIC DEAD-CENTER LATHES.

One attendant for two lathes. The attendants sit apparently idle.



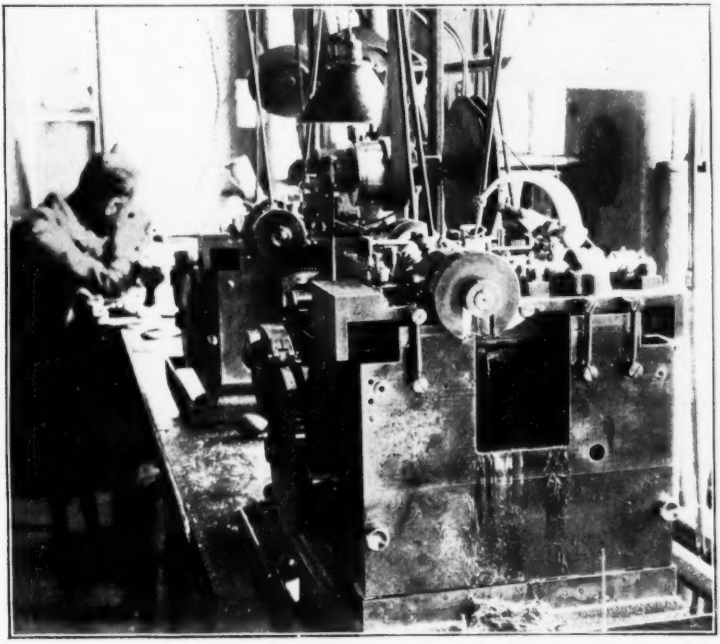
AUTOMATIC WHEEL-OPENING MACHINE.

For piercing the center of the wheel with a hole concentric with the teeth, after the teeth have been cut.



AUTOMATIC WHEEL-CUTTING MACHINE.

each of the six-spindle vertical heads with overhead plate holders, and to transfer the watch plates from one plate holder to another, successively, each plate holder correctly locating the plate over some spindle carried in one of the revolving spindle heads. It was also clearly possible to begin operations on the watch plates by supplying them in filled delivery magazines to the drilling machines, so that the transfer arm and hand could take a plate from the magazine and place it in the first horizontal plate holder, and from this first plate holder another transfer



PINION-MAKING MACHINE. WHOLLY AUTOMATIC.

Wire feed. The pinion is turned and has the teeth cut in it by successive operations before the machine releases the piece.

arm and hand could take the partly completed plate and deliver it to the next plate holder in sequence, until, at last, the final delivery arm and hand should place the completely drilled plate in a receiving machine, located at the end of the machine farthest from the delivery magazine through which the plates are given to the machine.

Here, then, was a clear, clean-cut, general scheme of plate drilling —which was, however, wholly impossible of construction with any

PNEUMATIC STAKING MACHINE. GREATEST PRESSURE USED IS ABOUT 3,300 LBS.

"Staking" is either a swaging or rivetting operation, by which two pieces are firmly united, and was formerly performed by a hand tool and hammer, and later by machines of the nature of a press. By both hand staking and press staking the polish is destroyed and has to be renewed, and the large flat wheel is "cockled," or distorted, by the setting up of strains in its thickness By the use of pneumatic staking machines, the pressure applied to effect the form change can be so delicately graduated at the beginning of the operation that cockling does not occur, and the polish of the parts is not defaced.

details then known in tool-making. The horizontal plate holder could be mounted on two of Maudslay's slides, one carried by the other, and these slides could be so moved as to bring any point in the plate over the axis of the tool carrying spindle below—but how?

The answer Church made to this apparently unanswerable question was wonderfully simple and wonderfully suitable.

It was wholly impossible to produce the double motion of the plate carriers by means of cams and levers, for two reasons; first, want of possible accuracy, and, second, want of room. It was impossible to place the required number of cams and levers in their proper relation to the plate holders and spindles, and cams and levers being the only means known for operating automatic tool members, it was clearly impossible to construct this ideally perfect plate-drilling machine. The requirement was some device which would move two comparatively heavy slides, quickly and certainly, to positions absolutely certain with relation to a fixed point, which employed no mechanism, and was not subject to wear of any description. Could absurdity of mechanical demand go farther?

Yet these impossible conditions were met in the easiest manner possible by the use of compressed-air pistons and cylinders, applied directly to the moving parts, so that, whenever air pressure was admitted to a cylinder, the piston instantly drove the connected member to a flat contact stop of hardened steel, the rapidity of traverse and intensity of the contact blow being perfectly controlled by the air-admission cocks, which are cam-operated. With this beautifully simple and per-

fect machinery Church moves his plate-holding slides with positive accuracy, revolving heads of hard-steel stop pins giving each hole location in the plate an adjustable definition which can be individually regulated to any degree of precision desirable, with the practical result of producing watch plates with no measurable or discoverable variation in the location of the holes.

Here, then, we have the highest known development of the possibilities of the tool-maker's art, due to the addition, by Church, of compressed-air actuating devices to Maudslay's slides and Stone's turret.

The compressed-air movement makes accuracy possible, as it never before was. Compressed air gives movements with any degree of force, within any space limitations imposed by the exigencies of tool construction, and—impossibility of impossibilities—without wear.

The largest plate-drilling machines have a delivering and receiving magazine, six plate holders, six spindle heads carrying six spindles each, making thirty-six live spindles in all, and seven tranfer arms and hands.

Within certain size limits, this compressed-air actuation in combination with these transfer elements, which are capable of taking a piece of work of any form and accurately locating it in a work-holder of any description, show the road to completely finishing any metal piece without direct manual intervention. That is to say, the methods and means now in operation at Waltham can be so modified as to produce any machine part without direct labor.

As to diameter-limit of work produced by this system, Church said that he thought his devices might be successfully and economically applied to pieces up to 10-in, or 12-in. diameter, and, in many forms of pieces, the length would be no bar to automatic finishing.

MERITS OF INDEPENDENT AND INDUSTRIAL TELEPHONE SYSTEMS.

By Kempster B. Miller.

A MORE complete monopoly than that enjoyed by the American Bell Telephone Company throughout its existence until the early part of the year 1893, probably never existed. This monopoly was based primarily on the fundamental patent of Alexander Graham Bell, covering broadly the art of transmitting speech by electricity, and secondarily on many hundreds of patents of greater or less importance covering apparatus and methods used in practical telephony. These later patents were the result of a wise and persistent policy on the part of the Bell company, and its manufacturing company, the Western Electric, to secure to themselves the right to manufacture and use all the inventions made by the engineers in their employ, and also to buy up all inventions of merit made by outsiders. So close-meshed was the web thus woven that it was thought that, even after the expiration of Bell's fundamental patent, the monopoly would still be maintained; for of what use would the broad art of telephony be to the general public if *all* of the apparatus and means for putting it into effect were still under the control of a single company?

With the expiration on March 7, 1893, of Bell's patent, which had been the subject of much litigation, and which, notwithstanding, had finally expired by virtue of having run its full term of seventeen years —numerous would-be competitors of the Bell company sprang into existence, and began their crusade with courage, in most cases born of absolute ignorance of the dangers ahead.

With the efforts of these early competitive companies, puny and of questionable character in many cases though they were, the present independent telephone movement in the United States began.

The outlook, at the start, was not encouraging. The Bell company controlled not only all the patents that were worth controlling, but practically all the men and consequently the knowledge. There was no practical literature on the subject, and telephone engineering,

The closely local adaptations of the telephone—its uses in mine, factory and workshop—have, rather curiously, been among the latest to be developed. Mr. Miller has a most interesting theme in describing this side of the evolution, so insufficiently noticed heretofore.

unlike other branches of electrical engineering, was not taught in the colleges. The only school was that of practical experience in the Bell company—a good one to be sure, but of little advantage to the struggling independent companies at that time.

To-day, the conditions are entirely changed. Many strong patents have expired; weaker ones have been declared invalid by the courts; while others are in the estimation of the public so palpably weak that they are quietly ignored. The knowledge of telephone matters has grown with the demand for cheaper and better service. Good telephone men have been created from available raw material, and many old ones have abandoned the ranks in which they obtained their primary training for the apparently brighter prospects of the new field. With the increasing prosperity of the independent companies, the questionable methods of the early promoters have been largely eliminated and now there is a growing tendency, on the part of both manufacturers and users, to respect the rights of others and to wage the warfare on a basis more consistent with a movement of its dignity and importance.

As a result of the labors in the independent field there are to-day nearly three thousand five hundred independent telephone exchanges in the United States, and of these two thousand are within a radius of 500 miles of Chicago. The remainder are scattered in nearly equal proportions east, west, and south of that center, the numerical representation in the South being probably a little the largest. The seven States having the greatest number of exchanges are Illinois, with 287; Ohio, with 274; Iowa, with 251; Pennsylvania, with 242; New York, with 240; Indiana, with 236, and Missouri, with 202. The total number includes all sizes from the small village exchange connecting perhaps fifteen subscribers, to that of the Kinloch Telephone Company, of St. Louis, Mo., equipped with a switchboard of 8,800 lines—the largest in the world. In the whole independent field there are about 700,000 telephones in use.

Contrasted with these figures the number of Bell exchanges in the

Beyond this, his review of the general telephone situation in the United States is most instructive because it displays the fundamental influences which have affected the progress of American telephone practice. These are vitally different from those prevailing in England and in the Continental countries where the telephone has formed a part of the postal system and has been under governmental administration. Electric-traction practice in the United States has made enormous advances, it is claimed, because it has developed under individual initiative and private management, without the proclaimed disadvantages of municipal or public ownership. It is interesting to follow, now, another branch of electrical engineering which has been peculiarly placed, resting to a great extent in monopolistic control, and to see how economic conditions have affected engineering practice in so typical an instance as is afforded by the telephone business in the United States.—THE EDITORS.

United States is something over 2,100, while the number of Bell telephones is approximately 1,500,000; so that, although the independent companies have about once and two-thirds as many exchanges as the Bell company, the latter has over twice as many instruments.

In the matter of toll lines and long-distance service, the showing of the independent companies does not appear so favorably in comparison with the magnificent system of the American Telephone and Telegraph Company, controlled by the American Bell. The system of the American Telephone and Telegraph Company alone, embraces over 10,000 miles of pole lines carrying about 125,000 miles of wire. These lines cover territory in which live over one-half the population of the United States, and, in conjunction with the Bell exchanges at the numerous points reached, constitute a system not even approached elsewhere in the United States or in any other country.

While the independent companies have no system so extended, there are many sections of the United States covered by a closer network of inter-urban lines than that of the Bell company in the same district. Several movements are well under way for establishing a great artery of communication for independent work, extending north and south, east and west; and there can be no doubt but that in a few years this work will be successfully accomplished on a scale commensurate with the needs of the people.

The great problem among the independent people at present, and one which is receiving too little attention, is that of the standardization of apparatus, line construction, and methods of operation, with a view to subsequent co-operation with the long-distance systems. In telephony, as in football and other affairs, merit of individual parts, or men, is of little use unless all work together as a whole. Team work is needed. The lack of uniformity in the independent field is due, first, to a lack of concerted action between the various operators; second, to the many and faulty designs of apparatus furnished by manufacturers in the early days; and third, to ignorance, in many cases, on the part of the management of the operating companies. A perfect wreck of a telephone may be made to talk fairly well over short lines, and many such are forced into service. It takes a good telephone for long-distance work. The greatest difficulty, however, is not with the instruments themselves, for any of the reliable manufacturers are now making instruments capable of operating satisfactorily over very long lines, but with the lines and the lack of uniformity in methods of connecting them.

This question should be taken up with more vigor, so that local

companies may build in such manner as to be benefited by the business over the long-distance lines of the present and future without the necessity of reconstructing their plants.

One of the most notable benefits arising from the new condition of affairs is the bringing of telephone service into small communities where the people could not hope to be reached by the large company. Co-operative companies have been organized in farming districts in the United States, each subscriber buying his own telephone and running his own line to some centrally-located farm house, where the switchboard—a small affair for perhaps twenty-five lines—is attended by the wife or daughter of the house for the moderate sum of fifty cents a month for each subscriber. The advantage, both industrial and social, of such a system to the farmer cannot be overestimated, the saving in long drives or walks over abominable country roads in winter being in itself enough to pay many times over the small outlay.

In the medium-sized towns the activity in the independent field has been greatest. Companies have been formed in nearly all such towns in which the Bell company operates, and in many not yet reached by it. The success of these has been marked. In spite of the poor apparatus, poor construction and poor management with which many of them were obliged to begin work, they have succeeded beyond expectations. Of course there are notable exceptions, but usually the failures have afforded horrible examples of how not to do things telephonic.

Not until recently has the patent situation or the engineering ability in the independent field made it possible to attempt successfully the building of very large exchanges. The expiration of certain fundamental patents has however opened up the field for large work, and the engineers in several notable cases have shown their ability to cope with the problem.

By offering lower rates and promising better service the competing companies, whether large or small, have almost invariably been able to secure nearly all the subscribers of the old company and many new ones, all bound by contracts running from three to five years. As for rates, the accompanying table shows, for several cities, the original controlling company's rates and those made by the independent company, and also the subsequent rate established to meet competition. It will be noticed from this that the combined rates of the new company and of the old after competition was started are, in nearly every case, approximately equal to the former rate of the Bell company alone.

TELEPHONE RATES, OLD AND NEW.

City.	Bell Company.		New Company.		Reduced Rates of Bell Co.
	Old Rates.	No. Phones.	Rates	No. Phones.	
Detroit, Mich.	$72.00 and $50.00	5,000	$40.00 and $25.00	5,200	$36.00 and $24.00
Grand Rapids, Mich.	72.00 and 60.00	1,300	36.00 and 24.00	3,100	36.00 and 18.00
Trenton, N. J.	$60.00	400	36.00 and 24.00	800	36.00 and 24.00
Richmond, Va.	$60.00 and $40.00	1,160	36.00 and 24.00	1,320	30.00 and 18.00
Fayette, Ind.	48.00 and 36.00	400	30.00 and 18.00	800	18.00 and 12.00
Roanoke, Va.	48.00 and 30.00	.....	30.00 and 20.00	400	18.00 and 12.00
Des Moines, Iowa.	72.00 and 60.00	735	24.00 and 18.00	1,200	36.00 and 12.00
Ft Wayne, Ind.	72.00 and 45.00	52	36.00 and 24.00	1,600	.....
Toledo, Ohio.	$72.00	450	54.00 and 24.00	2,100	.....
Elkhart, Ind.	$48.00 and $36.00	100	24.00 and 18.00	500	$36.00 and $24.00

It is frequently argued that the telephone is a natural monopoly, and that but one system can advantageously exist in a single community; but there is much to be said on the other side. In the first place, the service where a complete monopoly exists is likely to suffer. Corporations are not given to keeping their apparatus and methods thoroughly up to date merely for the sake of pleasing their customers, if they know they can keep them even with inferior service. Healthy competition in the telephone business, as in all others, brings about two desirable things, a reduction in cost and a betterment of service.

Aside from the improved service resulting from competition, there are other advantages due to two systems, which are often overlooked. The liability to tie-ups is greatly reduced. Many business houses will have telephones connected with both systems, and thus have two avenues of communication instead of one. The disability of one does not cut off the other. A still greater benefit, however, is the relief from the "busy" line annoyance.

The telephone is not of necessity a natural monopoly. Street car systems in a great city, or the railway systems in a great country, might be said to be natural monopolies in the same way. The system that takes a passenger rapidly and comfortably from any point to any other for a reasonable fare is the most desirable one. This might be done by a natural monopoly, but is usually accomplished by a system of transfers between the lines of one or several companies. Is the problem the same in telephony? At present no. In the future yes. The methods and apparatus of the independent companies are not as yet sufficiently standardized to make practicable a system of universal intercommunication. The courts have held, however, in more cases than one, that telephone companies are common carriers, and as the

purely technical difficulties are removed there can be no doubt that the co-operation of exchanges operated by opposing companies will not only be possible, but will be demanded as a necessity.

That telephone systems of widely different characters can be successfully connected is proven daily by the connections over the long-distance lines of instruments operating in radically different ways. Blake instruments with local batteries and antiquated magneto calling apparatus are with impunity connected with modern instruments operating with common battery and other recent improvements. In the city of Chicago, nearly all kinds of systems known to man are expected to give service in connection with each other.

The question of private installations is of hardly less general interest and importance than that of public exchanges. The ability to buy telephones and accessories outright, instead of being forced to pay as annual rental a sum several times their actual value, has greatly enlarged the field of usefulness of the telephone. The connection one with another of the house and the barn or store, or of the rooms in the house, of the various departments of a factory, store, or business office, of the shafts and buildings of a mine, of several bases of operation in field or other engineering work—and, in fact, of the branches of any industry or pursuit—is thus rendered possible with a moderate initial outlay and slight expense for maintenance thereafter.

A brief description of the main features of a factory system will probably be of interest to the readers of this magazine in view of the recent excellent series of articles pertaining to shop practice. A factory telephone system—or, in fact, any interior system—may be installed on one of two general plans. The first of these is commonly called the "house" or "intercommunicating" system, and has the advantage of requiring no operator. In this, each telephone has an individual wire passing to all of the other instruments in the exchange. Besides the individual wires, one or sometimes two common wires also pass to each telephone. The wiring of this system, therefore, involves the running to every station of one or two more wires than there are stations, and the most convenient way of doing this is by means of a cable having the requisite number of wires, tapping to each wire in it at each station. Each telephone is provided with a simple switching device by means of which it can be switched from its own wire, with which it is normally connected, to the wire of the station desired. Conversation is always transmitted over the wire of the station that is called and one of the common return wires. Each station has facilities for obtaining, by itself, a connection with any other station.

The great disadvantage of this arrangement is that it is necessary, when through with a conversation, to switch the instrument back on its own line in order that it may be ready to *receive* a call from another station. Automatic devices have recently remedied this fault, but at the expense of greater complexity. The house system is not to be recommended except in small plants where an operator is not available. Where more than ten instruments are to be installed, the second plan should be followed; this involves the use of a central station, to which all lines converge, provided with a switchboard attended by an operator. In this there is the extra expense of the switchboard, but this will be compensated for in most cases by the smaller amount of line wire and the greater simplicity of the instruments. The expense of the operator is not so great as would at first appear, as in small exchanges some regular clerk can add this work to other duties.

The central-office system, if properly installed, is less liable to get out of order, is more easily repaired, and, on the whole, gives better service. Besides this, the fact that the operator is (or should be) a creature of intelligence, and not a machine, is a great advantage—especially in a factory. For instance: The superintendent calls for a connection with Mr. Jones, foreman of the screw-machine department. The operator finds he is not in his department, whereupon Mr. Superintendent may say, "Well, find out where he is and tell him to call me up immediately." This the operator may readily do, and with no further loss of time on the part of the superintendent. The operator in such a plant becomes a general information bureau, and as such, an exceedingly valuable adjunct to the shop.

As to the cost of private telephone plants: Good telephones may be purchased in the United States, complete with batteries, at a price ranging from $10 to $15 each; switchboards, from $3 to $5 a line, with perhaps $25 additional for cabinet and operator's equipment; and good rubber covered wire, No. 18 or 20 B. & S. gauge (19 or 21 B. W. G.) at about $6.50 per 1,000 ft.

The following itemized list shows the cost of a very complete interior system of twenty instruments actually installed less than a year ago. This was operated on the common-battery plan, doing away with all batteries at the various stations and centralizing all sources of energy. All instruments and apparatus were strictly first-class.

This plant was put in with a view to reducing future expenses to a minimum, and the cost represents a fair average for the best construction in this class of work. It is possible by using instruments less expensively finished, and where less wiring is required than in this

case, to put in a first-class factory system for $20 an instrument, and in some cases for slightly less.

COST OF INTERIOR TELEPHONE EXCHANGE OF TWENTY STATIONS.

14 desk telephones complete, including granular transmitter and stand, bi-polar receiver and polarized bell, at $13.50.....	$189.00
6 wall telephones complete, including same parts mounted on wall-board, at $12.00..	72.00
1 twenty-five-drop capacity switchboard, with hand generator, mounted on quartered oak desk, with twenty drops installed...	95.00
1 operator's telephone set, including transmitter and stand, receiver and head band....	10.50
11,500 feet No. 20 B. & S. gauge (No. 21 B. W. G.) rubber-covered wire, braided, at $6.50 per 1,000 ft.....	74.75
8 cells, storage battery, 16 amp. hrs., at $2.00.	16.00
10 cells Leclanché battery, at $0.45.....	4.50
Sundries, knife switches, screws, staples, nails, annunciator wire and lumber.....	5.25
Labor—two men 11 days, at $2.00.....	44.00
Total	$511.00

There is still another phase of independent telephony—the opportunities offered to young engineers. Telephone engineering is an important branch of electrical and mechanical engineering, and both the Bell and the independent companies offer opportunities not fully appreciated, I think. In the independent field there is a notable dearth of good men to take in hand the more important positions. The way to these is about the same as in other branches of the profession.

The opportunities at present are probably better in the independent than in the Bell companies, because the systems of the latter are already highly developed. In the independent field more remains to be done, for, while a few companies have developed their apparatus and systems to a high degree of perfection, the problems of truly long-distance service—connecting the independent exchanges into one vast system, and of arranging for transfers of connections between competing companies—are yet to be worked out. These and many other problems are interesting and elusive, and there are enough of them to keep many of us busy for years to come.

THE STEAM ENGINE FOR THE ELECTRIC-TRACTION POWER-HOUSE.

By Charles Arthur Hague.

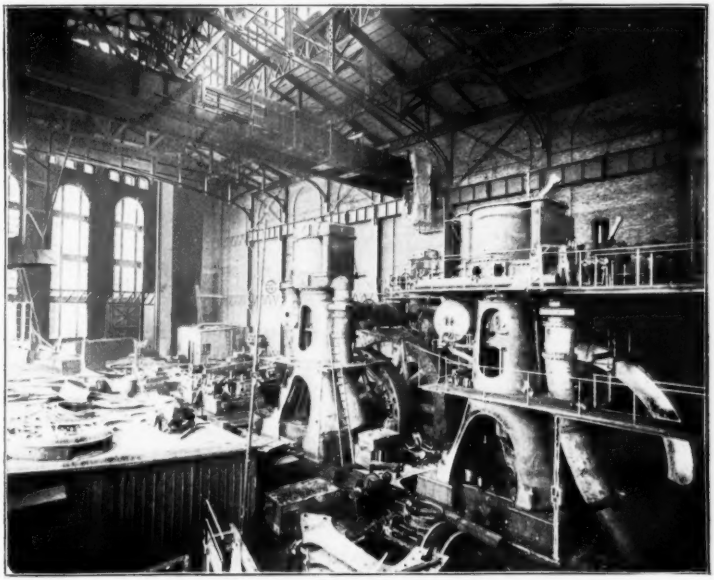
III.--PROBLEMS OF DESIGN AND ERECTION OF LARGE STEAM UNITS.

N my former article, I considered generally the peculiarly difficult conditions imposed by the problem of the engine for the traction power-house, and the leading tendencies of the practice which has developed, in the United States particularly, in effecting a solution. It seems appropriate to supplement the abstract exposition by a concrete review of embodied practice, as exemplified in some of the largest installations of the day.

In referring more explicitly to the larger plants for generating electrical power it will be seen that the day for very large units is fairly with us, and it has come about that the capital and courage is at hand necessary for the combining of numerous small power stations into one, or into a few large ones. The three-phase alternating current at a high potential when the power is concentrated, realizes an economy in fixed charges, value of real estate, etc., that fully justifies the generating of a current of 5,000 to 10,000 volts, and sending it to substations at accessible points, there effecting a conversion of the alternating current, by means of appropriate transformers and converters, into direct current of moderate tension for use in the car motors. These large engine plants can be comfortably placed upon ground aggregating as low as four-tenths of a square foot per horse power, which, compared with one and a half to two square feet per horse power for small plants, will argue very strongly in favor of economy in labor and cost of real estate. In this age it does not seem to matter as to the quality of the ground chosen, as with liberal piling and capping with concrete, the most unpromising locality may apparently be made as the solid hills. An example of one of these large plants may be cited. It is to contain, when finished, eleven cross-compound vertical condensing engines, each having a direct-connected alternating-current generator upon its main shaft. The indicated power, under best economical load, is to be about 5,000 h. p., with capacity for overload going nearly up to 7,000 h. p. The generators are of the alternating-current class with the fields revolving and with outside armature; special provisions for accessibility to the various details of engines and

dynamos are carefully and effectively thought-out in the designing of the machinery. The three-phase alternating-current will have a tension of 6,000 volts, which, in turn, will be changed to a 550-volt direct current at the points of use.

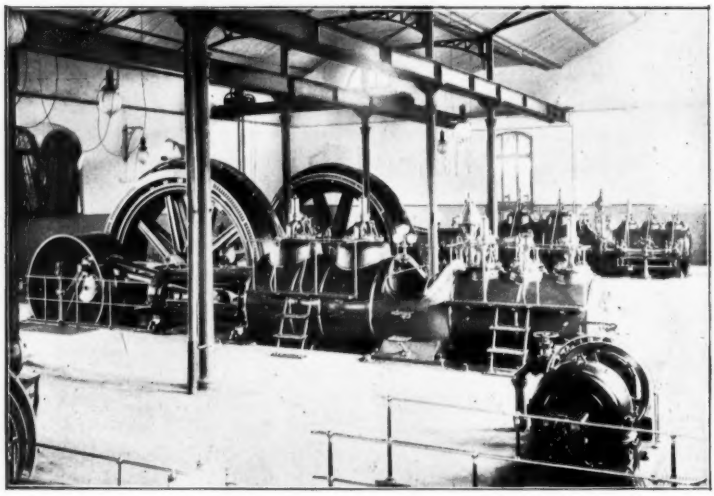
The condensing apparatus in these mammoth plants has not yet reached its height of perfection, and is no doubt a study by itself. Up to date the use of surface condensers with independent air and circulating pumps, seems to be the vogue, the condensed steam being mostly thrown away. Of course, in cities situated at salt-water ports,



INTERIOR OF THE NEW 96TH STREET POWER STATION OF THE METROPOLITAN TRACTION CO., NEW YORK.

Showing two of the large Allis engines in place and the foundations of a third.

the feed water must be bought and paid for, in the absence of the return of the condensed steam from the surface condensers to the boilers. But the necessary amount of courage has not yet been apparent to return this water, with all its risks of cylinder oil, although a gross saving of from $50,000 to $80,000 per annum might be attained. A system of filtration and analysis of the feed water, in competent hands, would no doubt be possible enough, and its cost would yield a very large dividend as an investment, by the saving in cost of fresh water.



AN ELECTRIC GENERATING STATION IN ZÜRICH.

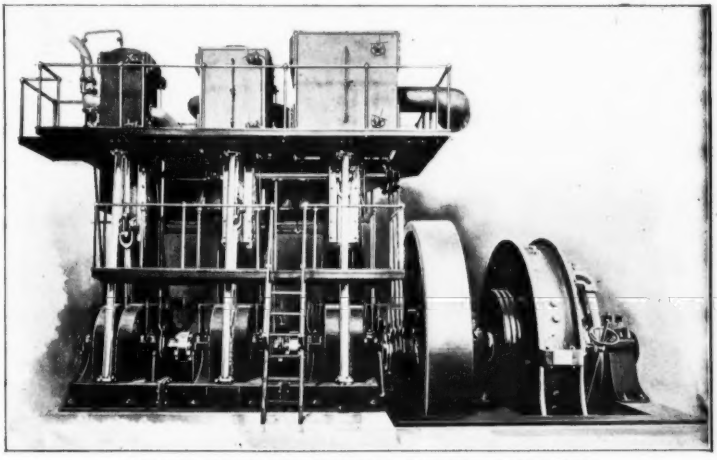
Two direct-connected sets of 1,000 h. p. each; 100 rpm. Horizontal tandem-compound engines by Sulzer Bros.

The steam and exhaust-pipe systems are also food for study, and the possibilities of bold and effective treatment of these items upon such a large scale are admirably met. The steam is brought into the engine room, passed through a separator, and thence to the high-pressure cylinder; the exhaust from the low-pressure is carried down to the basement, through feed-water heaters, and thence to the condenser. Provisions are also made for automatically exhausting into the atmosphere, in case of need; and in some plants, arrangements are made in the design of the engines for sending live steam to the low-pressure cylinder and exhaust steam from the high-pressure to the condenser, thus cutting out either cylinder in case of necessity.

It may be of interest to some to note in what a short time radical changes have been made in engineering in this power-house practice. Less than ten years ago an investment, and a large one for the time, was made by a large company desiring electric power, in six horizontal triple-expansion engines with mammoth fly wheels belted to pulleys on counter shafts. The counter shafts, in turn, were belted to the generators, and were arranged with a system of friction clutches for desired manipulation. After about five years' use of the plant, aggregating 10,000 h. p., the progress made by the manufacture of electric

machinery became so apparent that the company could not resist the evidence that it would pay to rebuild and re-arrange, and were rather astonished to find that each unit in the space used could just as well be 5,000 h. p. as of the 1,700 first designed. In making the changes, although some of the triples were saved and revamped, the new engines were put in of the cross-compound type.

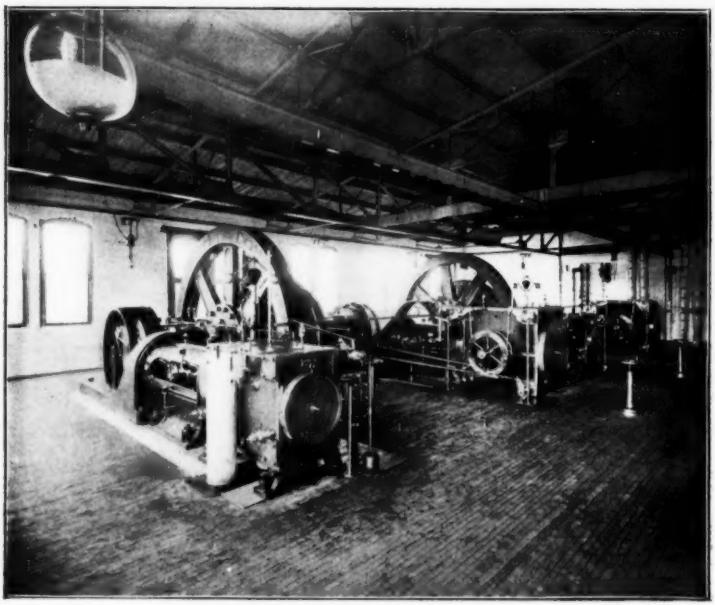
One of the largest horizontal condensing engines for electrical generation, if not the largest yet produced, and may be, the last one so large that ever will be built, will show somewhat the massiveness of modern engine construction. The possible horse power is 5,000 with 165 lbs. steam pressure; the engine is arranged as two tandem-compounds coupled into a four-cylinder cross-compound by means of a shaft common to both sides; the main shaft is of forged steel and made solid, 27-in. diameter at the generator field centre; main journals 24 in. diameter and 42 in. long; weight on the bearings, two in number, is nearly 150 tons; main bearings have water-jacketed shells; the cranks are of the disk pattern, each 8 ft. 4 in. diameter; crank pins 13 in. diameter and 11 in. long; cross-head pins 11½ x 11 in.; the cross-head shoe presents 722 sq. in. of bearing surface for wear; fly wheel weighs about 83 tons; the valves are gridiron slides, six valves for each cylinder, the cut-off controlled by a shaft governor; the pumps for the condensing apparatus are driven by electricity.



TRACTION POWER HOUSE INSTALLATION IN BUENOS AYRES.

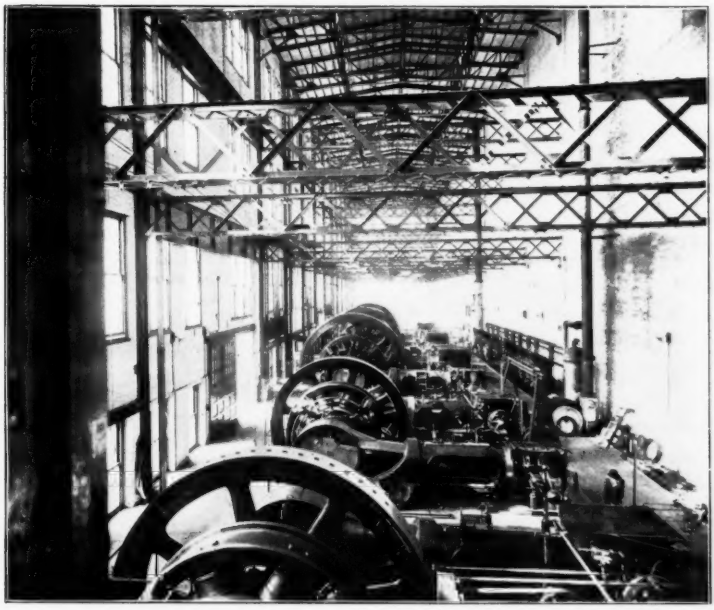
800 h. p. vertical triple-expansion engine with 525 kw. generator. Cylinders 14, 23, and 40 x 36; 125 rpm.

The various problems coming to the surface, in the matter of construction of the larger of the power-house engines, are extremely interesting as engineering considerations, and upon the successful settlement of some of them depends the question as to whether the engine of so large size and for so severe service can be constructed at all. The marine engine has gone as high in units as perhaps 15,000 h. p., but the variable loads to be taken care of strictly within the engine itself do not exist for the marine engine, nor does the continuous service under heavy stress begin to approach, in marine practice, the titanic demands found in the railway power-house. The regular line steamships have a continuous run of less than a week and then they have a week of inactivity. The famous Oregon, with all proud respect to her, made a continuous run of sixteen days as the longest without stopping. But, after all, the main point is that the steamship can be stopped without great hardship; the power-house engine, on the contrary, with the thousands of diversified interests at its mercy, can not



HEAVY-DUTY CROSS-COMPOUND CONDENSING ENGINES, SPRINGFIELD STEAM RAILWAY, SPRINGFIELD, MASS.

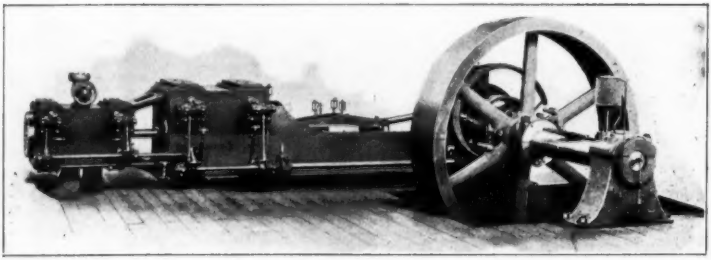
Cylinders 26 and 50 x 48; 90 rpm. Direct connected to 800 kw. generator. Fly wheels of sectional type weighing about 100,000 lbs. Hooven, Owens & Rentschler Co.



146TH STREET POWER HOUSE OF THE METROPOLITAN TRACTION CO., NEW YORK.

Three 1,200 h. p. and two 600 h. p. horizontal cross-compound Corliss engines.
The E. P Allis Co.

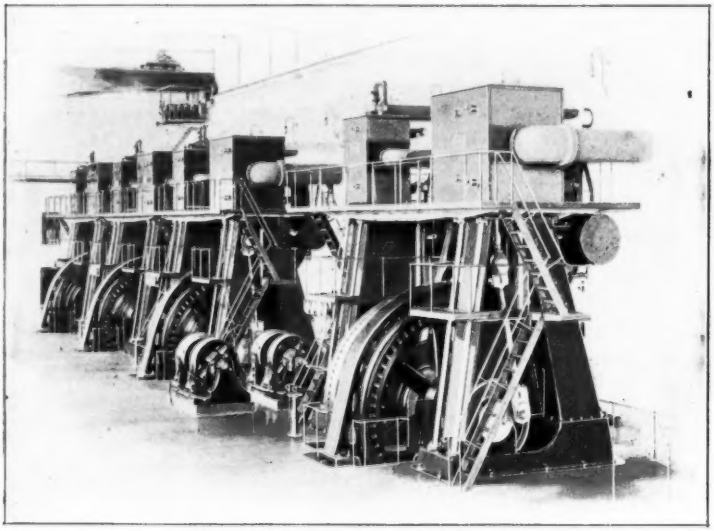
be brought to rest in many cases without results damaging beyond thought. The single item of crank shaft has grown to be something which nothing but gradually growing up to can make tolerable; in fact, the question of forging a crank shaft for engines of 5,000 h. p. and upwards is one upon which depends the production of these large units of railway power. The shaft forgings have a tensile strength of over 80,000 lbs., with 50,000 lbs. as the lowest limit of elasticity, and the material will lengthen some 25 per cent. before parting under test. Open-hearth furnaces carrying temperatures of 4,000° F. are employed in producing the size and quality of steel ingots from which such shafts are forged, and the forging is mostly accomplished by hydraulic pressure instead of by steam hammers, the pressure process permitting the flow and adjustment of the metal during the operation, instead of condensing the outer surfaces and leaving the centre spongy. Pressures as high as 14,000 tons are used in the work of hydraulic forging, the horse power of such work going up at times to



HORIZONTAL TANDEM-COMPOUND ENGINE, TRACTION POWER HOUSE AT CHELSEA, MASS.
Cylinders 14 and 26 x 30; 450 h. p.; 160 rpm. McIntosh & Seymour.

the enormous figure of 500,000,000 foot-pounds of energy per minute. The pressure at the pump sometimes exceeds 6,000 lbs. per sq. in.

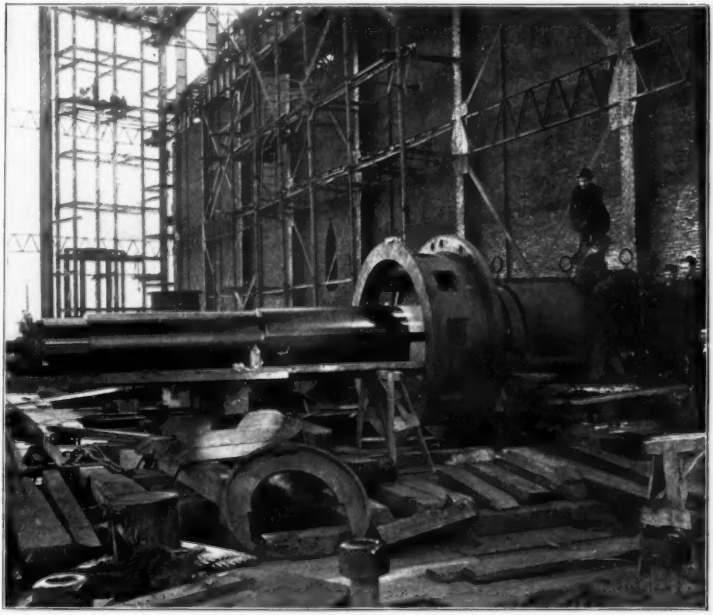
The object of the fluid compressed-steel ingots is of course to produce such ingots practically homogeneous throughout, or at least to confine the objectionable qualities to the centre of the piece where the defects may be removed by boring them out after cooling, thus leaving a sound, close-grained piece of material from which to forge a hollow



AN ELECTRIC GENERATING STATION, BOSTON, MASS.

2 500 h. p. vertical cross-compound engines direct connected to 1,500 kw. alternators. Cylinder dimensions. 28 and 58 x 48. 120 rpm. McIntosh & Seymour.

shaft; there are also incidental advantages in heating the cylindrical ingot not to be obtained with a solid. A steel mandrel nearly filling the hole in the ingot serves as an anvil, and the shaft is forged both inside and out, thoroughly compacting the material during the process. The forging is then annealed properly and oftentimes tempered in oil. Such shafts for power-house engines have been made of nickelized steel, fluid compressed, forged upon a mandrel by hydraulic pressure, annealed, and tempered in oil, having a diameter of 37 in. at the



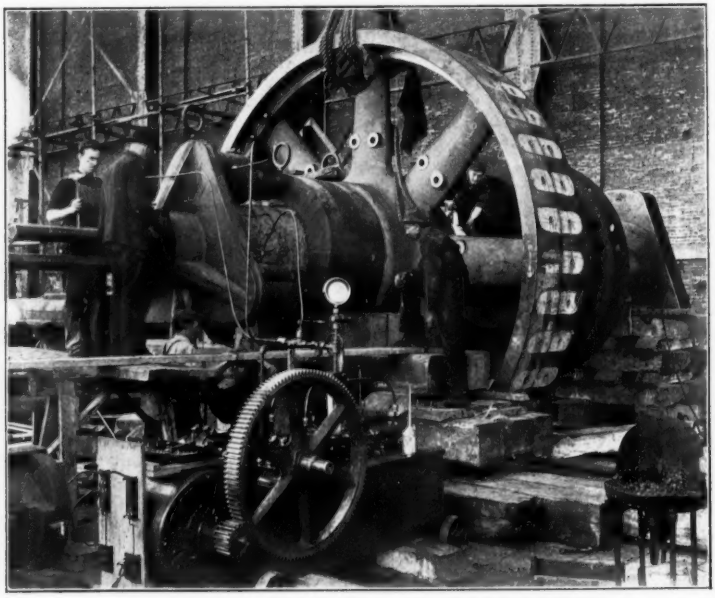
ERECTING A 5,000-H. P. ENGINE, METROPOLITAN TRACTION CO., NEW YORK.

The shaft in position and fly-wheel center placed.

seat of the fly wheel, diameter of main journals 34 in., diameter of crank seats 30 in., diameter of hole through centre 16 in., length of shaft 27 ft., and weight, when finished, 76,000 lbs., elastic limit 35,000 lbs., and 25 per cent. elongation of material under test.

An engine with such a shaft would have a 42-in. high-pressure cylinder, a 92-in. low-pressure cylinder, a stroke of 60 in., and a speed of 75 revolutions per minute, steam-jacketed cylinders, piston rods 9 in. in diameter with a 3-in. hole through their centres and made of

the same material as the shaft, connecting rods of the same material with 3½-in. hole through the centre, and having a neck diameter of 9½ in. at the cross head and of 13 in. at the crank-pin end, cross-head pins 12-in. diameter, crank pins 15-in. diameter, with 4-in. hole

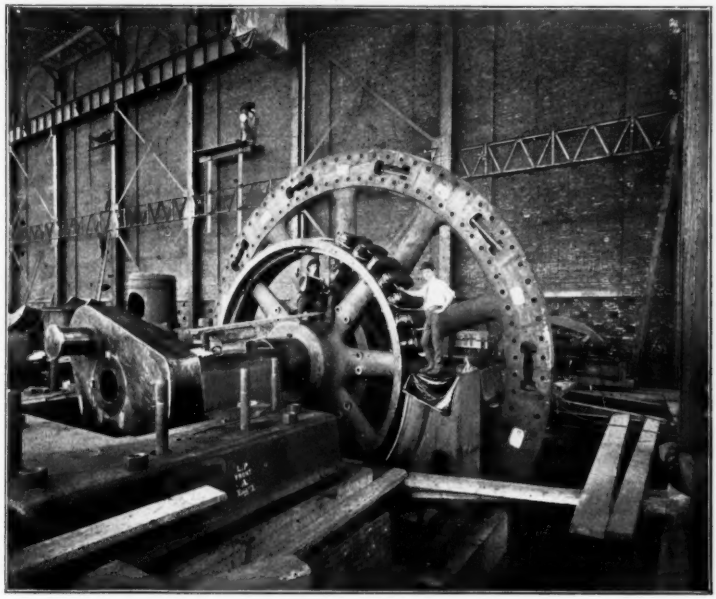


PRESSING ON THE GENERATOR SPIDER OF A 5,000-H. P. ENGINE.
Electric-driven hydraulic presses in service in erecting the engines in the new power station of the Metropolitan Traction Co. New York.

through the former and with a 5-in. hole through the latter. The weight upon the main journals of such an engine, including the shaft, the cranks, the revolving field, and the fly wheel, would be about 260 tons.

The erecting of engines so huge away from a shop and with temporary facilities sometimes presents tasks of serious moment, especially when, in these days of severe competition, all items of cost and expenses must be carefully weighed and, in making up an estimate, all unnecessary handling of material must be avoided. In a recent case of the kind a rather novel but entirely successful method was employed in the use of hydraulic jacks applied through the medium of an electrical pressure pump, for forcing into place upon the

shaft the wheel centre, the spider of the generator, and the cranks. The fluid employed was oil, under a pressure of a little less than 10,000 lbs. per square inch, requiring about 11 h. p. to do the work; the time required to do all of the forcing was only a few hours, when once the apparatus was ready for work; the shaft weighed 68,000 lbs., the 16-ft. diameter spider 35,000 lbs. and the cranks 25,000 lbs. each. The final assembling of the parts of the fly wheel, and the securing together of the same, by cold riveting under the pressure of a hydraulic-jack riveting apparatus capable of exerting a pressure of more than 450 tons, is another expedient brought about by the exigencies of the situation. This system of cast-iron hub, arms, and a central portion of rim, with plate-steel laminations secured to the outer surfaces of the

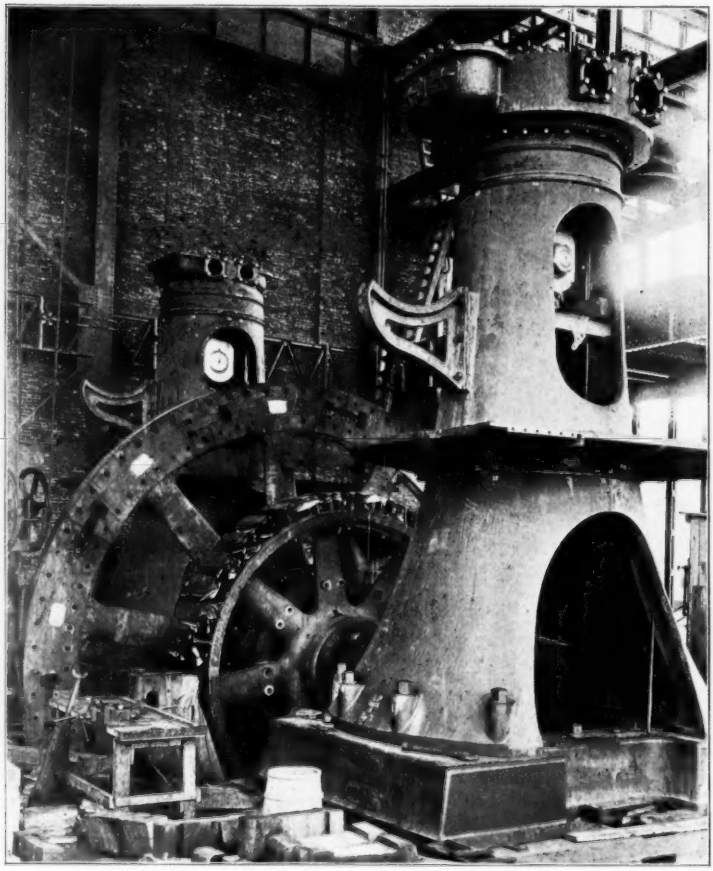


ERECTING A 5,000-H. P. ENGINE FOR THE TRACTION POWER HOUSE.
Showing the shaft in place, the fly-wheel built up, and work in progress on the electric generator.

sides of the rim, is beginning to be regular practice for the large, heavy wheels of these great high-powered engines—suggested, no doubt, by the danger of using cast iron alone, where strains of such magnitude occur in the attempted acceleration and retardation upon

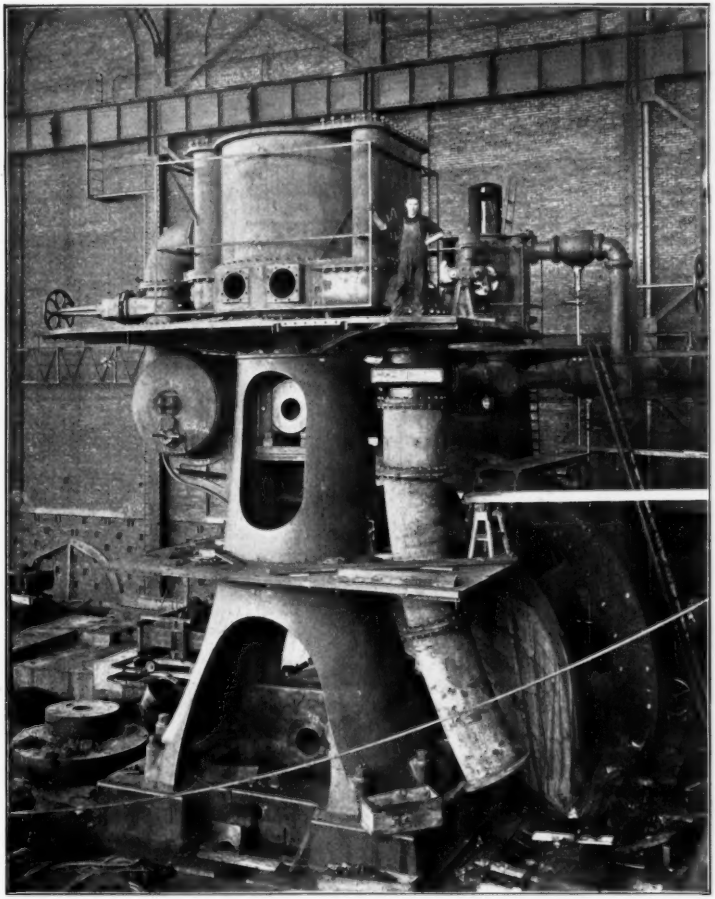
so enormous a scale. It can be imagined what this will be in a range of energy liable to extend from no load to fifty per cent. overload, to say nothing of some of the peculiar shocks to which an engine is liable in handling the electrical mode of energy.

The admission and distribution of the steam in these large engines, with the close regulation required, and with absolutely nothing but



ERECTING A 5,000-H. P. ENGINE, METROPOLITAN TRACTION CO., NEW YORK.

Showing the arrangement of high and low-pressure cylinders on opposite sides of the fly wheel, and the manner of bolting together the fly-wheel and generator to relieve strains on the shaft.



A 5,000-H. P. VERTICAL CROSS-COMPOUND ENGINE, PARTLY ERECTED.

One of the large units in the new (Ninty-sixth Street) power house of the Metropolitan Traction Co., New York, approaching completion. The man standing on the upper platform affords an idea of the size.

the fly wheel to depend upon, makes the problem in this respect as difficult as any yet attempted by the steam engineer. The failure to grasp the idea that an electrical current of high voltage and great quantity is sadly lacking in inertia has been the cause of great and extended trouble. A cable plant expends about 40 per cent. of its

ERECTING A 5,000-H. P. STEAM ENGINE.

A single one of the 5,000-h. p. units in the new Ninety-sixth Street station of the Metropolitan Traction Co., N. Y., showing the main frame, shaft, fly-wheel, and generator erected.

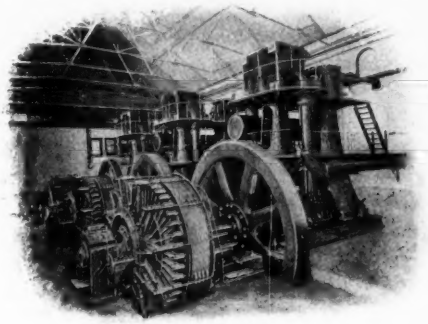
power in maintaining motion in the cable, so that in addition to the fly-wheel there is the mass and resistance of the cable to steady the engine. With a steamship in motion the entire ship is fly-wheel and steadiment combined, and hence some of the valve details successful in marine practice completely fail when applied to a power-house engine on shore with nothing but some tons of wheel to depend upon and exposed to the erratic actions of an intangible phase of energy; a

mode of motion so erratic, indeed, that in an unforseen second, if a fuse fails to blow, the direction may reverse and the generator be turned into a motor so suddenly as to jump the main shaft with all its ponderous attachments clear out of its bearings. The power-house engine is a unique production confined to the past dozen years or so.

Therefore, the induction and exhaust-valve mechanism, especially as regards the handling of the admission, cut-off, and release of the steam in this employment of steam power, is particularly exacting in its demands for adaptation to the duty to be performed. There are various kinds and types of valves for steam distribution, each having its intelligent and sincere advocates. The general field may be divided into two classes—one, in which the drop cut-off or releasing valve gear is used, and in which the regulator or governor simply indicates the point of cut-off without doing any of the work; the other, in which the so-called positive cut-off is used, and in which the regulator or governor holds and helps to drive the cut-off mechanism.

The mere statement of the two cases, it seems to the writer, points out the choice as to which is the better for power-station engines; and there is no mistaking the evidence of the times to the effect that the Corliss system so far is, and has been, the most extensively used and the most successful. With the valves across the cylinder heads, so as to reduce the clearance to a minimum, and with double eccentrics and arrangements for continuing the detachment of the cut-off hook beyond the ordinarily available point, it will doubtless be a long time before this system will be superseded in large and important engines for electric-railway power stations.

[For the illustrations of the power stations of the Metropolitan Traction Co., New York, THE ENGINEERING MAGAZINE is indebted to the courtesy of Mr. M. G. Starrett, Chief Engineer.]



ACTUAL EXPERIENCE WITH THE PREMIUM PLAN.

By H. M. Norris.

URING the fifteen years that have elapsed since its invention, the premium plan has been adopted by a number of leading establishments, in but two of which has it failed to prove a success. In the first instance it was withdrawn by the management on account of the excessive earnings of the men; in the second it was refused by the employees for reasons presumably interesting enough to record. This was in the early part of 1899, when an attempt was made to introduce the system into the works of The Bickford Drill & Tool Company, Cincinnati, Ohio.

The workmen were almost all union men, opposed to piece work. The difference must be made clear to them. Explanatory notices, posted in the shop, might create a wrong impression and lead the men *en masse* to reject the plan. Apprentices, through expectation of benefit, and a portion of the men, through fear of discharge, might accept it, but these were not the best elements to win at first. The probable "kickers" should be won at the outset. The second perplexity was as to the tickets—how they should be worded and used, to avoid causing alarm by the "time limit," and to make clear the distinction between "time" per piece and "cents" per piece. A verbal explanation, instead of any ticket, seemed most promising. Next came fixing of the premium rates. Mr. Halsey's policy—liberality with time limit rather than with premium rate, would make it necessary, in many cases, to fix the time limit considerably higher than that consumed at present, in order that the men might not become discouraged by the smallness of their earnings, the time having already been reduced very near to its minimum. This would not do. It would be equivalent to raising the men's wages without the assurance of a corresponding gain to the employers. They would receive a bonus even though they did not increase their output. The shop could gain nothing except by an increase in the work produced. The gain to the works and the workmen should begin together. This involved the necessity of paying a higher premium rate. I decided to divide wages with the men. Having thus decided upon my course, I began making a card

* Speaker Reed is said to have defined the difference between theory and practice somewhat thus: "Theory takes account of all the conditions that can be discovered and calculated; practice deals with all the conditions there are." Mr. Norris has dealt with the labor problem on the hard ground of practice. His experience is therefore of the highest value to managers who are facing, or soon may meet, similar conditions.—THE EDITORS.

index of comparative statistics, showing the time consumed in the past on each operation of our standard line of production.

When the indexing had progressed sufficiently to enable me to commence operations, I went to one of our oldest men, spoke with approval of his time on a recent lot of sleeves (16 hrs. 43 min.) and told him the shop would, of course, be glad of any possible further reduction of time, and at the same time would like to see him share in the advantage. I proposed, therefore, to split his wages on every hour he could save under 17 hours. His answer—that it would suit him all right but he wanted no piece work—gave me an opportunity to explain to him that it was not piece work but the premium plan, aiming at division of savings and unification of interests; in any case, it was not compulsory and could be dropped at any time.

The man looked skeptical, and as though he were but half convinced. Still he tried it, with the result shown in the ticket below.

PREMIUM TICKET, SHOWING EARNINGS OF

Mr. *John Smith* No. 52 Tool No. 214

On *Turning, Boring and Facing*

6 Pieces. Marked 11 A 3 For Piece Order No. 5215

TIME	HRS.	DATE		REMARKS
Commenced	10	7—24—99		
Finished	10.30	8—3—99		
Time Limit	102	RATE	EARNINGS	
Actual Time	88½	28	24 78	
Premium	13½	14	1 89	
Labor Cost of Work			26.67	
Labor Cost per Piece				
Inspected				
By		Foreman		Read Notice on Reverse Side.

I then approached a number of the others, and in course of time had most of our leading hands working under it. Thus encouraged, I brought out the ticket shown above, the back of which read:

NOTICE.

"It is the purpose of the management of this Company to compensate its employees according to their individual ability to turn out good work at minimum cost, and in order that this may be done by a system that will not, in any way, endanger the present scale of wages, it has been decided to adopt the premium plan. Under this system each workman is assured his regular 'going rate,' whilst being afforded an opportunity of earning a substantial bonus on all work which he completes within the specified time set by the office. Tables have been prepared showing the average time consumed in the past in the performance of each operation on the several parts of our standard machines. These averages will be regarded as representing the minimum time within which the work must be completed in order to entitle the workman to a premium. It will not be difficult, therefore, for everyone to add something to his earnings, the amount of increase depending solely upon the individual effort of the workman. There is no risk of loss, but every opportunity for gain. A time limit once fixed will not be changed, except through the introduction of new methods of doing the work, so there need be no fear of earning too much money. Those who earn the most will be worth the most.

This slip shows on the reverse side the amount earned by you on the work indicated in the heading. The rates per hour at which premiums are figured vary according to the going rates of the workman, a schedule of which is given below.

Rates.	Prem.	Rates.	Prem.	Rates.	Prem.
5 — 11	= 5	16 — 17	= 8	22 — 23	= 11
12 — 13	= 6	18 — 19	= 9	24 — 25	= 12
14 — 15	= 7	20 — 21	= 10	26 — 27	= 13

"The conditions governing the payment of premiums are as follows:

"Premiums will not be paid on any work that is not completed to the entire satisfaction of the foreman.

"Every workman must assure himself before commencing a piece of work that it will finish to the required size, whether the work is to be completed by him or others.

"No allowance can be made for bad material or deficient workmanship in any previous part of the work unless the same is pointed out to, and indorsed by, the foreman as soon as discovered.

"This slip must be carefully preserved, both for your own reference, and in order that it may be returned to the office in good condition in case of your leaving our employ.

"All premiums will be paid on the first regular pay-day following the completion of the work upon which they were earned."

For a time everything went smoothly, but one day a man came with a claim that a mistake had been made in the time limit on some wall radial arms. Only 84 hours had been allowed, while he asserted that the job had previously taken 86 hours. He admitted that he had made $1.40, but thought he should have made more, and remained unconvinced and unsatisfied, even after reference to the index showed the

recorded times to be 86¾ and 82½ hours. His position was that the man who saved an hour should be paid for the entire hour—piece work was better than the premium plan, but he did not want either of them, and would sooner go on as he had been doing before the innovation. I assured him he need not take the extra money—there was nothing compulsory in it.

This was the beginning of the trouble. Time commenced to go up. Instead of coming within the old records, it ran above them. The men were "soldiering." I spoke to the foreman. He said he had noticed it, and asked what I thought had better be done. I told him we would have to make an example of one of the men, but must wait until we were sure of premeditated action. Time continued rising. Something had to be done at once. We had notified each of the delinquents a number of times without avail.

"Pick out the slowest, and one you can spare best, and let him off on Saturday," were my instructions to the foreman.

On entering the works the following Monday, I noticed a number of men at the wash troughs. Upon enquiring the cause, the foreman told me that one of the men had quit out of sympathy for the discharged employee and that the others had followed right along after him. This was all he knew about it. He doubted if half of them knew themselves why they were leaving. Five or six others started to go out, but returned, saying they wanted to know what they were going out for before they threw up their jobs.

I then sent for one of our oldest men—oldest in point of service—and asked him if he could tell me why the men had gone out so unceremoniously. He said the men did not like to work by the premium plan, that they were all doing the best they could for the company, and that it hurt them to see their old shop-mate discharged.

I told him that it hurt me, also, to discharge an old hand, but that, under the circumstances, there seemed nothing else to be done. "I notified him," I said, "a number of times that he was falling behind in his work, and had he had a legitimate reason, he could have spoken to the foreman, who is always willing to make a liberal allowance for hard castings or other causes of delay beyond the workman's control. If he had run behind on but one or two jobs, we would have thought nothing of it, but it became chronic. Work that he used to do in 16 hours before the introduction of the premium plan lately took him 24 hours, and it looks to us very much as if he had agreed with some others working near him to keep his time as high as possible in order to defeat the object of the new system."

He did not think this could be true, being unwilling, from his knowledge of his fellow workman, to believe he would be a party to any such arrangement. He suggested, as causes for the increase in time, a run of hard castings, delay in waiting for the cranes, or possibly illness. I suggested that, in any such case, the man needed only to come to me and he would be sure of consideration.

I then dismissed him and sent for another man, who very promptly expressed his surprise that Blank had been retained by the company as long as he had. "The union," he said, "forbids its members working under either the piece-work or premium system, and here lies all the trouble. There is no question but that the premium plan is all right, but you can't get them to see the difference between it and piece work. I understand that they have resolved upon making a general strike in all shops using either of these systems, not only in Cincinnati, but throughout the country."

Later in the day I left word at the general office that I would like to see two of the men when they came that evening for their money. When they appeared at my office I asked if I should expect to find them in their places in the morning. One of them answered that he did not think he would be back, but the others would do as they chose. The trouble, he said, in answer to my questions, was their belief that the system under which their fellow had lost his job would prove equally bad for them. He was a good man, an old hand, and should have more consideration. I pointed out the moderation of our course, our slowness in acting even under long provocation, our regret at having to dismiss the man, and our sincere desire to do justice, to make the work agreeable, and to grant all reasonable requests, citing recent instances. I offered any desired explanation of the premium plan, and assured them again it was in no way obligatory. The spokesman replied that he understood some of the men boasted of having made a good thing out of it, but none of them liked it. If they suddenly cut down their time, I would think they had been loafing all the past years and would want them discharged. The minute a man began cutting his time, it showed he had not been doing his duty in the past. Furthermore, it cast discredit on the foreman, who ought to know whether a man was doing the right thing or not. Time records were all right, but the foreman ought to decide these things.

I assured him the foreman did decide these things, but that was a side issue. The discharged man would not be reinstated. Before making his discharge a cause for leaving, however, I thought they had better think it over.

Next morning they returned to state the conditions under which a strike could be avoided. They were the reinstatement of the discharged man, and of all who had gone out in sympathy, and the abolishment of the premium plan. To my reply that this was impossible, they responded that there was no more to be said. They had given their message and would return with my answer.

"My answer is this: If the strikers wish to return to their places, and do so at once, they may; if the men do not wish to accept the additional compensation due them under the premium plan, they can leave it at the office, give it to the poor, or turn it over to the union, but Blank cannot come back. You may say, also, that the management of this company will always reserve the right to discharge any and all employees whom, in its judgment, it is better without. Further, that we shall, at all times, reward our employees for increasing production by any method we think best."

They said they would report my words and bring the men's decision in the morning. Matters looked grave. The conditions seemed to be either an unconditional surrender or submission to indefinite stoppage at a time when the shop was overcrowded with work and behind in its orders, many of which were accepted under penalty. There was little prospect of getting work done outside. Surrender, on the other hand, would forever destroy the discipline of the shop and place its management in the hands of the union. The action of the men seemed wholly causeless and unreasonable—they were certain to lose, but so were we. It seemed incredible the union could sustain them. But if the union forbade men working under the premium plan, I must either fill the shop with non-union men or withdraw the plan. Yet what was there to withdraw? Must we agree not to give money to any of the men against their wishes? With the idea of bringing home to the men a sense of the ridiculousness of the situation, I posted the following notice:

> "Since there seems to be some misapprehension in regard to the introduction of the premium plan of rewarding our workmen for their efforts toward increasing production, we wish to state that there is nothing compulsory about the system, and in order that this fact may be clearly understood we declare that
>
> THE PREMIUM PLAN IS HEREBY WITHDRAWN
>
> from all employees who do not desire it. No one shall be forced to accept any compensation beyond his regular wages. It will be be paid to those only who ask for it."

The next morning I received a call from the business agent of the International Association of Machinists, Cincinnati and vicinity—Mr.

Seifreat. He said he had called in the interest of the International Association of Machinists, to which nearly all of the men belonged, to talk the matter over in the hope that some agreement might be arrived at whereby the difficulty might be adjusted amicably.

"Very well," I replied, "if the men now working in this shop have appointed you their representative, I shall be glad to talk with you. What complaint have they to make?"

"They seem to feel pretty sore over the discharge of one of your old hands which, I am informed, was brought about by the introduction of the premium plan. They claim that he was one of the most industrious workmen you had, and that you had probably made some mistake in fixing the time limit on his work. Do you not think that this is quite possible?"

"It mght be possible on one or two jobs, but not on all his work. Our records are kept too carefully to permit of many errors, as you will see from an examination of our methods, which I shall be glad to show you."

I then explained our system in detail, showing how the time limits were fixed, not from the time made by the most rapid workmen, but from the average time made by all. "Limits cannot, however, be fixed by rule of thumb," I said. "In a repetition business, such as ours, the same work is frequently done by one man a large number of times. Here is a card containing a record of the time consumed in boring and turning each of the last six lots of No. 0 mitres. The time runs: 144, 76, 60, 38, 27, and 25 hours respectively. This work has not yet come under the premium plan, but you will note that I have allowed 30 hours—the mean of the last three figures, each of which was made by the same man. He knows he can do the work in 25 hours, and that the other 5 hours is all clear gain to him. What could be fairer? In this case the risk is ours, not his. If he does not beat his last time, we will lose five times the half of his wages. You will see that the trouble does not rest with us. We are always anxious to retain the services of our old experienced hands, and discharge none without good and sufficient cause. We have but a limited number of heavy tools, which makes it necessary to work each to its fullest capacity. Most of our men are cutting their time daily, while the time of the man in whom you appear so interested shows a daily growth."

"Possibly the knowledge that he had to get the work out within a specified time made him more or less nervous. Could not this have had something to do with it?"

"Yes, and that is one reason he was not discharged a month ago."

"But can you not give him another trial? He has been with the company so long that I think he is entitled to special consideration. Put him on a different machine, and then, if he prove unworthy, let him go. This will settle the difficulty—now that you have abolished the premium plan—and the men will return in the morning."

"I have no objections to the return of the strikers, as I think they have already begun to realize the absurdity of their course; but the abolishment of the premium plan and the return of Mr. Blank are out of the question."

"Suppose I tell him to come down, say, in a day or two, and——"

At this, however, I became impatient and closed the interview, telling Mr. Seifreat that the men were acting foolishly and he was in the wrong in upholding them. If a strike was to be ordered, we would fight it; meantime I bade him good day. An hour or two later he returned, bringing the discharged man and one of the strikers.

"After leaving you this morning," he said, "I met Mr. Blank and told him what you had said about falling behind in his work. He says he has never done a full lot before of some of the work called for by the tickets you showed me, and does not see, therefore, how you can regard his time as excessive."

"Mr. Blank's memory is very short," I replied. "He has done each of these jobs several times, as the job tickets will readily verify. Let us look at them." With this I produced a number of time cards. "Here," I continued, "is the record of his last job. You will note that he took 55¼ hours to do that which he did the time before in 49½ hours, and the time before that in 46 hours."

Blank endeavored to use the excuse of "hard castings," even against a malleable-iron job, and to my offer to go further into the cards, if enough cause for our action had not already been shown, Mr. Seifreat advanced further efforts to have the man given another trial. I told him my answer was final—we would fight a strike, if needed, but would not recall our action in discharging the man.

This ended the strike. The men were all at work next day—that is to say: they were all there except Blank and one other whom I had said we did not care to have back. For five days nothing was said by either side. Then came pay-day. I went to a number of the men and said: "There's a premium due you from last week; would you like it enclosed in your envelope?"

"No, sir," came the very prompt answer from each.

I was nonplussed, chagrined, embarrassed—almost disheartened. I felt that it was of no use to wrestle with them longer—that it would

be impossible to overcome their prejudice—that I must abandon the effort. The age of miracles had passed. The blind could not be made to see. The premium plan had received a heavy blow. Its recovery seemed doubtful. Still I hoped.

Another week passed. In the meantime I communicated with Mr. Halsey. He advised that I get the men together, explain the object of the premium plan—using as a text the increased earnings shown in an article he had just published,* and then propose that they agree to work under it earnestly and honestly for a year—that is, give it a fair trial for that length of time. We, on our part, to agree to submit the matter to them for vote at the termination of this period, and to abide by any decision they might reach regarding its further use. I thought the suggestion a good one, and resolved to act upon it.

Meantime I talked the matter over thoroughly with one of the brightest and most influential workmen in the shop—an Englishman of many years' experience and much more than average intelligence. His attitude, put into a single paragraph, was this:

"I don't see anything wrong with the principle of the plan, but the men won't have it. They think it the entering wedge to piece work, and if you argue from now till doomsday, you'll not be able to convince them otherwise. To accept it on trial for a year with the privilege of doing away with it at the end of that time, is not feasible for the reason that although they might wish to drop it they would not dare to for fear that you would insist upon their maintaining the same break-neck speed they had attained while working for the premiums. You have asked me to speak to you as man to man, and I do so. There will be trouble the moment you attempt to press the matter. Of this I am positive. But if you can convince our general manager, and he says: 'Boys, it's all right,' everything will go smoothly."

There seemed no alternative. I must either treat with the officers of the union direct, or give up the attempt to introduce the system. I chose the former, and wrote Mr. Seifreat as follows: "Will you be kind enough to furnish me a copy of the by-laws of the International Association of Machinists, also a statement setting forth the objections held by that association to the premium plan of paying for labor, invented by Mr. F. A. Halsey, of New York?" The reply read:

"As I am not familiar with Mr. Halsey's premium system I cannot give the objections this association may have to it, but believe that sections 1 and 3 of article 22 of our constitution would prohibit any

*Experience With the Premium Plan of Paying for Labor, *American Machinist*, Vol. 22, No. 10.

member from accepting work under it, as it comes under the head of piece work." This confirmed my suspicion that the fight was being made in ignorance of the very subject in dispute. However, I turned to the sections cited and found them as follows:

"Sec. 1. Members introducing any person or persons other than machinists, machinists' apprentices and others as specified in Sec. 2, Art. I, into the trade and assisting them shall be heavily fined for the first offense and expelled for the second."

"Sec. 2. Any members introducing or accepting piece-work, or running two machines in any shop where it does not exist, shall be subject to expulsion."

"Sec. 3. On and after May 1, 1898, all members of the International Association of Machinists shall refuse to work by the piece or run two machines. This shall also apply to those engaged under the piece-work system."

Seeing nothing prohibitory to the premium plan in that, I asked Mr. Seifreat to call and take the matter up in person.

He came and listened attentively to all I had to say. I read him Mr. Halsey's letters, showed him his paper, referred to his article, spoke of the objections to the day's-work plan, pointed out the bad features of the piece-work plan, called attention to the weak points of the gain-sharing and differential-rate system. I explained the workings of the premium plan—talked, in fact, until I had exhausted every argument on the calendar. But it made no impression. He persisted in confounding the premium plan with that of piece-work and other systems, classing together and pronouncing as bad all methods tending towards increasing a workman's output. He declared them to be simply a scheme of the employer to augment his bank account at the ultimate expense of the workingman. He said he believed all such systems worked injury to both the employee and the employer—to the former, by engendering a feeling of rivalry and discord among the men, and to the latter, by compelling him to accept inferior work.

"It is the transient workman only," he said, "who derives any benefit from them. He comes into a shop, pushes through an abnormal amount of work, gets his stake, and pulls out, leaving his output to be reworked at the expense of the company. This record is then taken as a standard of efficiency. The old hands must either slight their work in the same manner, in order to avoid falling behind the dishonest man's time, or look for other jobs. I have been with a good many firms and have never known it to work otherwise."

"Your argument may be more or less true of piece work," I answered, "but not of the premium plan. Under the former, the wage-cost per piece of merchandise remains the same no matter how great the increase in output of the workmen; hence, if the piece prices are

fixed too high, the manufacturer must either cut them or continue to pay extravagantly for his work. Instead of receiving a substantially equal division of the savings, he gets but little, practically all of it going to the workmen. Under the premium plan, half the saving in wages goes to the workman and half to the employer, rendering a cut unnecessary, even though the time limits should prove considerably higher than necessary. A time limit is never changed after being once fixed, and if you wish it, we will give you a written guarantee to that effect."

"If the time limits continue in force, the system might, perhaps, be a benefit; but systems are not devised except as a business move on the part of those in charge of a shop, and, in the end, the workmen are invariably the losers."

This interview was followed shortly by a call from Mr. James O'Connell, grand master International Association of Machinists, and third vice-president American Federation of Labor, who, after expressing regret at the men's action in striking before they had so much as stated their grievance to the company, argued the case as follows:

"The premium plan partakes of the nature of piece work and, like it, causes a constant straining to increase production, which, besides lowering the standard of workmanship in the shop in which it is employed, serves to develop the worst element of human nature—selfishness. I have devoted the best years of my life to the study of this problem, and have never known an instance where the introduction of any system other than the day's-work plan did not ultimately result in the men being charged with all breakage and spoiled work."

"That can readily be done under any system," I replied, "but it is not our purpose to cause the men to suffer such loss. We shall certainly pay no premiums on spoiled work, but, if a man runs behind on one job, he will not be obliged to make it up on the next, and in no case will he earn less than the current rate of wages. It rewards the strong without injuring the weak."

"Even so, labor derives no benefit. For example, let us suppose that your daily wages amount to $1,000 and that, through the use of the premium plan, your output is increased until this account becomes $1,250. The men gain an advance of 25 per cent., but the output of the shop, figured on the basis of an equal division of wages for time saved, is increased 50 per cent. This is more than you can dispose of. You lay off a part of your force, retaining only enough men to maintain the former output. The result is that you drop back to your original pay-roll of $1,000, which, instead of being distributed among five

hundred men, goes into the pockets of the relative few. The rest remain idle, and labor, as a whole, loses."

"You are then opposed to everything that tends to minimize labor. In other words, you think mankind suffers through the invention of the locomotive because of the vast number of stage drivers, horse dealers, saddlers, and carriage makers who were thrown out of employment when overland coach travel was relegated to the past?"

"No, I believe in the minimization of labor, and hope to see the day when the week's work will be done by the pressure of a button."

"The two thoughts do not harmonize. But let us confine ourselves to the point in question. The premium plan undoubtedly stimulates production, and, if our competitors operate their shops under this system, we must either do likewise or submit to being undersold, with the inevitable result of losing trade. Wages must be reduced or production increased. We cannot pay a dollar for work obtained by our neighbor for seventy-five cents."

"We have no wish to injure trade. The union recognizes the fact that the manufacturer has some rights, and that there should be one law for all. We must either prohibit the use of all such systems, or devise some means of controlling them. This question will probably receive considerable attention at our approaching convention, and I would recommend that you allow the matter to rest until I am able to advise you of what action is taken. The men are not prepared to accept it at this time, and if you attempt to force it upon them, we shall be obliged to fight."

"To my mind, the sole trouble lies in the men's lack of confidence in their employer, to overcome which I have framed a proposition which, in point of fairness, must appeal to every intelligent workman. See if there is in it anything to which you would be unwilling to agree." I then handed him the proposition, which read:

"Conditions under which the employees of The Bickford Drill & Tool Company agree to work faithfully and conscientiously under the premium plan of paying for labor.

"1. That each employee shall be guaranteed his regular day's-work wages so long as he shall remain in the employ of The Bickford Drill & Tool Co.

"2. That the time limits shall never be lower than the best time made with the same tools under the day's-work plan.

"3. That no one shall be discharged because of failure to reduce his time below the limits.

"4. That, in addition to his regular wages, each employee shall be paid one-half his regular hourly rate, less any fraction of a cent, for each and every hour he may reduce his time below the prescribed limits.

"5. That a limit once fixed shall not be lowered, except through the introduction of new methods of doing the work.

"6. That all premiums shall be paid within two weeks of the completion of the work upon which they were earned.

"7. That at the end of one year's time the system will be withdrawn from all those not wishing to continue working under it.

"8. That, if withdrawn, the employees shall not be required to work at the same rate of speed without an equivalent in wages."

"That seems fair enough," said Mr. O'Connell, "and if you have no objections I will take this with me and lay it before our general executive board." There was nothing more said worthy of record, but a week or ten days later I received the following letter:

"Dear Sir:—I beg to inform you that in compliance with my promise, I submitted to our general executive board the premium plan for paying for work performed. I am instructed by the members of the general executive board to say to you that, owing to the fact of it being within a couple of weeks of our convention in Buffalo, they cannot see their way clear to take any action in the matter at this time, believing that some steps will be taken at our convention in regard to this and other plans in connection with operating machine shops.

"I wish to say I have included in my biennial report to our convention your proposition in full, and I will let you know as soon as convenient after our meeting what action has been taken upon the same.

I trust, therefore, that you will see your way clear to make no change in your present method of operating your shop until after our convention meets."

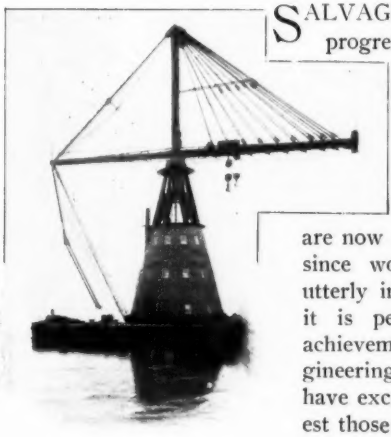
In my acknowledgement of this letter, I said:

"If the delegates present at your approaching convention can be made to realize the distinction between the premium and piece-work systems, we have little doubt but that they will wish to have the premium plan incorporated in their platform. It guarantees full current wages to the poor workmen, benefits the mediocre, and obtains for the skilled far more than they are able to earn under the day's-work plan. Its action is, in fact, automatic—each workman being paid according to his individual ability to augment production."

I must, however, reserve for the next issue of this Magazine the history of the case in the convention—the delineation of the attitude of organized labor toward one of the most advanced systems for stimulating true economy and ensuring to labor its full share of the reward. It is significant of the tendency in the United States—a country which has heretofore won its industrial prominence largely through labor's freedom from the narrow views and narrow bonds which are cramping the older world.

RECENT NOTABLE SALVAGE OPERATIONS.

By Waldon Fawcett.



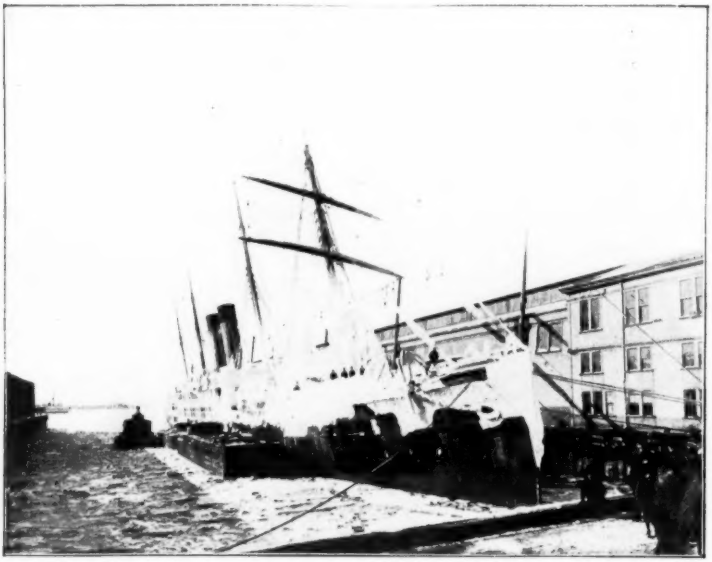
SALVAGE work on the high seas has progressed, in so far as the difficulty of work attempted is concerned, directly in proportion to the improvement in methods and facilities. In view of the fact, therefore, that marine wrecking operations are now undertaken which a few years since would have been regarded as utterly impracticable, if not foolhardy, it is perhaps not strange that the achievements of this branch of engineering science during the past year have exceeded in importance and interest those of any previous period in history.

The year 1899 has seen placed in service larger wrecking vessels and more complete equipment generally, and attendant thereon, the introduction of new methods which have proven successful in the highest degree. Moreover, in one case—that of the disaster to the American liner Paris—it has taught the greatest maritime nation in the world that, in point of efficiency, its wrecking plants and their operatives are surpassed by those of a new sea power.

The present era of notable salvage operations may be said to have begun, properly speaking, with the efforts to recover several of the Spanish cruisers sunk in the engagement at Santiago, Cuba, in July, 1898. The initial work, the raising of the cruiser Maria Teresa, was a decidedly arduous performance, particularly by reason of the governing conditions of wind and weather; but the methods followed in the prosecution can not be said to have shown any radical departure from those represented in previous practice. The loss of the vessel, while en route to an American port, brought the incident to a sudden termination. The official court of inquiry, to be sure, exonerated the officers in charge from any blame for the abandonment of the vessel, although it was stated incidentally that the failure of the pumps to

clear the ship was due in a measure to neglect to have the bilges properly cleaned out.

The effort of Naval Constructor R. P. Hobson to interest the government in an effort to raise the cruiser Cristobal Colon by means of air bags, while it provoked considerable discussion at the time, re-



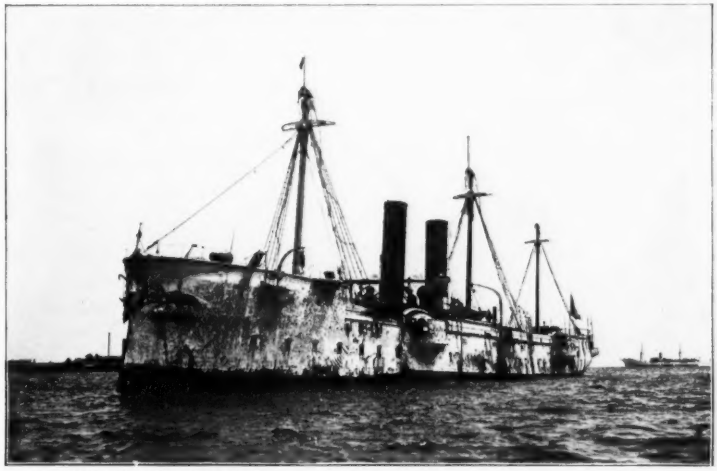
THE WHITE STAR LINER GERMANIC, RAISED AFTER BEING SUNK AT HER PIER, NEW YORK, FEB. 11, 1899.

sulted in no lasting beneficial results. That the scheme is practical under certain circumstances there can be little doubt, but that it would have justified the expenditure which would have been necessary in this particular case is extremely unlikely. Marine wreckers, for some time past, have employed air bags and made use of compressed air in varied manner; compressed air was utilized successfully as long ago as 1880 by George W. Dickie, manager of the Union Iron Works, San Francisco, in the recovery of the British ship Jessie Osborn. Mr. Dickie is still an advocate of the method, making the contention that, in view of the fact that one pound of air more than balances two feet of water, it is far more rational to pump compressed air into the hold of a sunken vessel than to endeavor to pump the water out. The main argument in favor of the air compressor as against the water pump is found, of course, in the fact that in the use of the former no

energy is wasted. All of the air pressure applied is effective, whereas in the case of the pump usefulness is limited to the excess of the pump capacity over the rate of leakage. Obviously, the pumping method can only be successful in the case of comparatively small leaks.

The recovery of the former Spanish cruiser Reina Mercedes constituted the most important, as well as decidedly the most interesting, work of this character performed in West Indian waters. The work of raising the Merçedes was begun on January 2, 1899, and on March 1 she was towed into Santiago harbor. She lay on the brink of a ledge with 26 ft. of water inshore and 42 ft. outshore, with a list of 28 degrees. All the woodwork, including the officers' quarters, was torn out and the wreckers built a cofferdam on the main deck just forward of the bridge. In this dam 30,000 ft. of lumber, 6 tons of bolts and 800 yds. of canvas were used.

After the watertight dam had been pumped out the vessel rose and

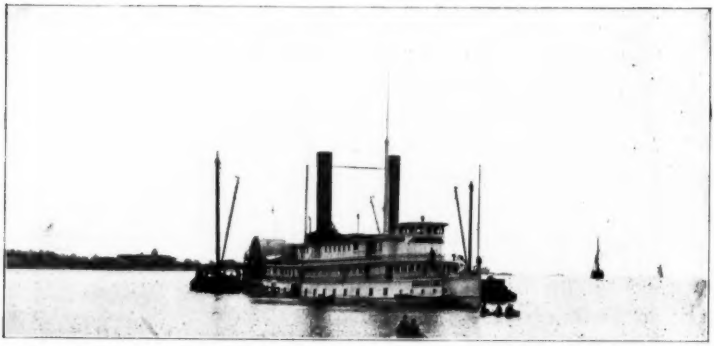


Copyright, 1899, by Samuel E. Rusk.

THE EX-SPANISH CRUISER REINA MERCEDES.

Sunk during the blockade of Santiago in the summer of 1898. The photograph was taken after she had been raised and brought to the United States.

was towed into Santiago with 12 ft. of water in her hold. She drew on delivery at Norfolk, Va., only 22 ft. of water. All the guns, with the exception of two 16-cm. rifles, were taken off. The wrecking force had to overcome many obstacles. For instance, holes were found so large that they could not be caulked with pine corks and accordingly

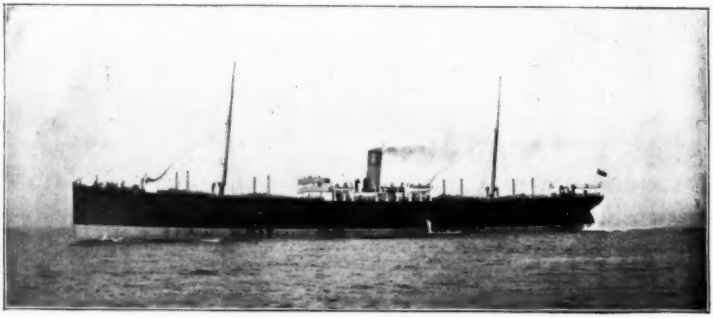


STEAMER CITY OF WORCESTER, SUNK IN NEW LONDON HARBOR, MAY 29, 1898

had to be covered with iron plates. Pneumatic tools of American manufacture were utilized extensively in the operations, and by means of the drills over three hundred holes were drilled under water.

Probably the most remarkable achievement in the line of wrecking and rebuilding to be found in maritime history is represented by the reconstructed steamer Milwaukee, which was turned out in the summer of 1899 at the yard of C. S. Swan & Hunter, at Wallsend-on-Tyne, England. Something of the magnitude of the undertaking to make this vessel again fit for service may be imagined by a glance at the photographs herewith reproduced.

The Milwaukee, a vessel of 483-ft. length and 56-ft. beam, went ashore near Aberdeen in September, 1898, a huge rock penetrating the hold for a length of 30 ft. and to a height of 8 ft. above the tank top.



STEAMER MILWAUKEE AS SHE ORIGINALLY APPEARED.
She presents practically the same appearance since her salvage and reconstruction.

When the salvage operators saw that it would be impossible to save the entire vessel, it was decided to blow her in two with dynamite. This was done successfully and 180 ft. of the fore-end was left on the rocks, while the after end was towed to a dry-dock.

To sever the steamer, successive charges of dynamite were applied, each charge being distributed over a length ranging from 4 ft. to 6 ft., and the charges varying with allowance for the thickness of the steel plates to be severed. Such was the quality of the steel, however, that more than 520 lbs. of dynamite were utilized. Despite the heavy

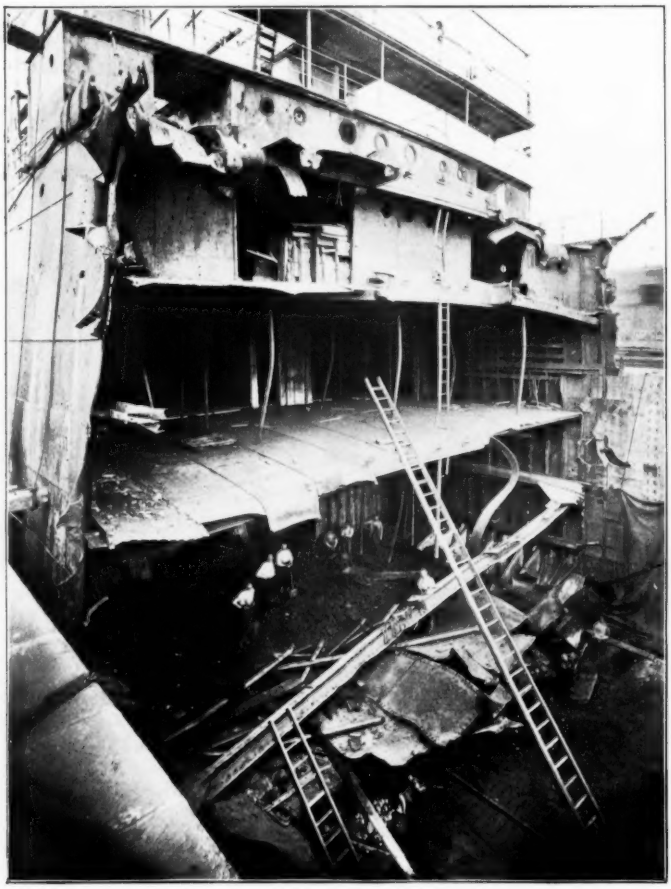
THE SALVED PORTION OF THE MILWAUKEE MOORED IN THE RIVER TYNE.

charges exploded, however, none of the parts of the structure adjacent to the belt of cartridges was seriously damaged.

The saved portion of the vessel depended for flotation, until placed in dry dock, upon a transverse watertight bulkhead at the forward end of the boiler space. The saved portion extended from just before the forward end of the navigating bridge to the stern, the engines and boilers being thus preserved. It was towed to the Tyne and moored in the river until a new bow was built, launched, and made ready for connection to it.

A remarkable feature of the removal of the after end of the Mil-

waukee was found in the fact that it was towed with the bulkhead end foremost, and that the tugs were assisted by the ship's own engines. On the arrival of the half of the boat at the Tyne, her builders set

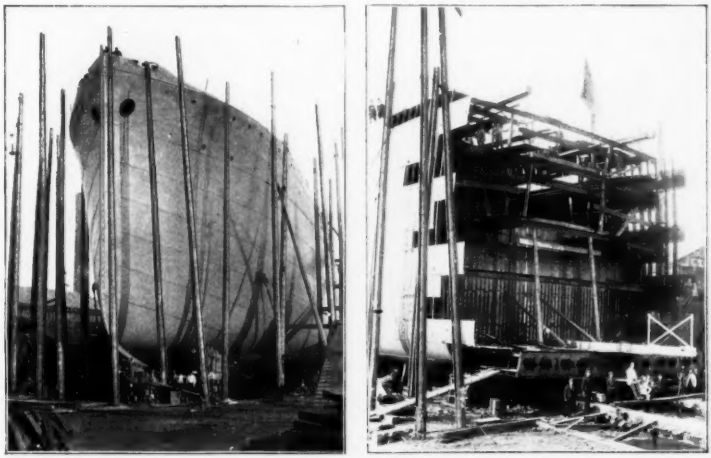


THE SALVED PORTION OF THE MILWAUKEE IN DRY DOCK, SHOWING THE EFFECTS OF THE DYNAMITE.

about the work of reproducing a fac-simile of the lost bow; so well did they succeed that a person ignorant of the facts would never know that he was not looking at the original bow, while even those persons who knew the circumstances of the case were unable to point out the

line where the junction of the new and old portions was made. Moreover, so successful was the attempt to dry-dock the two sections of the ship in correct relative positions that but little subsequent adjustment was necessitated.

Possibly the most creditable demonstration of the perfection of modern dry-dock methods was afforded by the precautions taken by Harland & Wolff, the Belfast, Ireland, shipbuilders, in the preparation for repairs on the Peninsular & Oriental liner China. The release of this vessel, after she had been for nearly five months on the rocks off the island of Perim in the Red Sea, was of itself so interesting an accomplishment as to warrant a few words in passing.



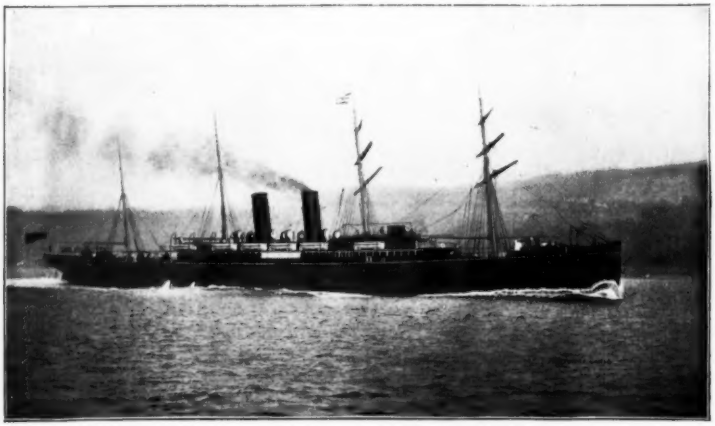
FORWARD AND AFTER PART OF THE NEW BOW OF THE MILWAUKEE.
On the stocks, ready for launching, at the yards of C S. Swan & Hunter, Wallsend-on-Tyne.

The China, a vessel of 500-ft. length, 54-ft. beam and 7,899 gross tons was, late in March, 1898, driven on a rock which made an immense hole in her double bottom. When the salvage steamers arrived, early in the following month, it was found necessary to remove the rocks by submarine blasting before any attempt could be made to fill up the holes. Continuous bad weather made these operations difficult, and several months of steady work were required before the divers finally began the task of tightening the steamer's bottom. About the middle of September the pumps of the salvage steamers, with an aggregate capacity of 14,000 tons of water per hour, were called into requisition and the work proceeded with little interruption.

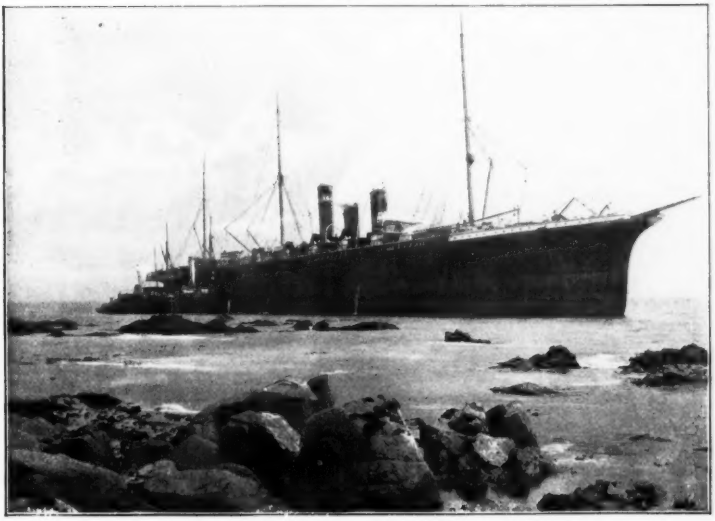
When the China was brought back to the yard of her builders for repairs it was, of course, impossible to resort to ordinary methods of dry-docking, by reason of the condition of the vessel's bottom. Before the docking operations were undertaken, it was decided to carry the weight of the fore end of the ship on square timber logs of about 20-in. measurement, taken horizontally through the vessel from side to side. For this purpose holes of sufficient size had to be cut through the side plates and no fewer than sixteen of the logs were "rove" through the China, and under the projecting ends upright timber supports 16-in. to 18-in. square were fitted.

The supports rested upon shoes on the bottom of the dock, to which they were secured by braces, while the heels of the logs were strapped round as a precaution against splitting. Of course, all the uprights had to be cut before the ship entered the dock and positions were marked upon the bottom of the dock for the shoes to sit upon. A large number of timber shores were also fitted to assist the supports. A number of the latter were carried up from the bottom of the dock as uprights, while others were on various altar courses or steep sides of the dock, and so cut at the head as to take an angle plate which fitted close up under the edges of the overlapping shell plates. Altogether there were three rows of these supports, consisting of square pitch pine logs from 12-in. to 18-in. measurement.

When the water had been pumped out of the dock the injuries to the China were found to be of a most unique character. The bottom



THE STEAMSHIP CHINA BEFORE SHE WENT ASHORE OFF PERIM



AMERICAN LINER PARIS ON THE MANACLES ROCKS.

of the ship was driven out of shape for a distance of fully 220 ft. from the stern, and the keel was arched for nearly 200 ft., being set up 9 or 10 ft. The plates were corrugated and dented in a most remarkable manner. Moreover, the damage was not confined to the forward end, there being a number of fractured plates only about 100 ft. from the stern.

The success of a Hamburg salvage corporation in floating the American liner Paris, stranded on the Manacles rocks near the entrance to the English channel, after British firms had abandoned the attempt, has very naturally caused an immense amount of comment. The whole effort of the British salvors was to pull the vessel off the rocks by means of tugs assisted by the steamer's own engines.

The Paris went ashore May 21, and the three large wrecking boats of the German corporation did not make their appearance on the scene until June 7. Just thirty-three days were consumed in the patching, blasting, and pumping necessary for the removal of the rocks which held the vessel. The inspection made by the divers disclosed the fact that a hole about 12 by 16 ft. in size had been made in the vessel's bottom by great pinnacles of granite, which had penetrated her outer shell about midships under the first and second boiler rooms.

The vessel rested, as it were, upon a great pivot. The work of the

MALLORY LINE S. S. LEONA, BURNED AND SUNK AT HER PIER ON THE EAST RIVER, N. Y., OCT. 5, 1899.

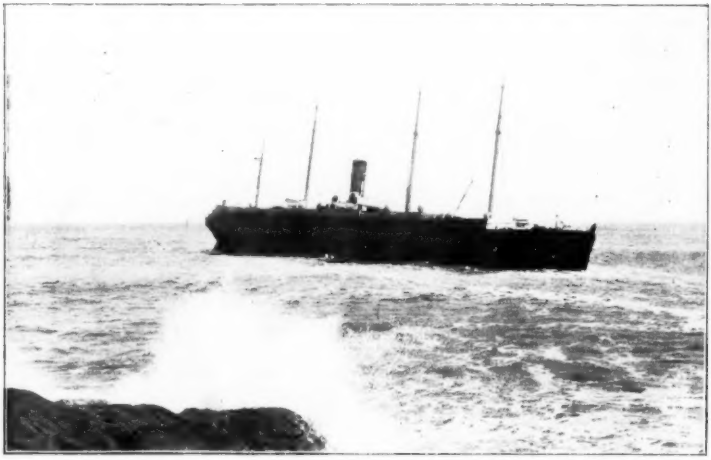
Righted and pumped out by the Merritt & Chapman Derrick and Wrecking Co.

RAISING THE BARK LA ESCOSESA, CAPSIZED AND SUNK OFF ROBBINS' REEF LIGHT, NEW YORK HARBOR, MARCH 23, 1899.

WRECKERS AT WORK RAISING THE SUNKEN STEAMER CATSKILL.

divers was seriously impeded by sea-weed as thick as jungle grass and 10 ft. high, and the removal of this was the first task undertaken. Later it was towed to a point where the tide caught it and carried it out to sea. The Germans early decided to abandon the plan of the British wreckers, which was to lift the vessel off the rocks by means

THE CATSKILL AFTER SHE HAD BEEN RAISED, PATCHED, AND PUMPED OUT.
The work was done by the Merritt & Chapman Derrick and Wrecking Co.



THE WRECK OF THE NORSEMAN, OFF MARBLEHEAD, MASSACHUSETTS BAY.

ROCKEFELLER STEAMER DOUGLASS HOUGHTON, SUNK IN ST. MARY'S RIVER AND BLOCKING TRAFFIC BETWEEN LAKES HURON AND SUPERIOR.

of pontoons and bags inflated with air and placed under the keel. Instead, they adopted the plan of blasting away the teeth of granite which held the liner.

Before this could be undertaken it was necessary to do an immense amount of patching from the bow aft to the midship section, and the steamer's bow was lifted out of the water by adding weight to her stern and filling her after compartments with water. The danger of injuring the vessel restricted the size of the blasts, but in all more than 15,000 cu. ft. of rock were removed; moreover, this was all done under water. As rapidly as the boulders were detached, hawsers were made fast to them and they were dragged out of the way by the wrecking steamers.

Difficulties of the greatest magnitude presented themselves when the work had advanced to the point at which it became necessary to blast away the last pillar of granite holding the Paris. The steamer had been filled with water flush to her depth of 50 ft., in order to raise her bow, and, inasmuch as her own pumps could not cope with this, holes had to be cut in her decks and sides in order that a powerful wrecking steamer might lie alongside and suck out the water ballast. As the vessel righted, the rush of water tore out some of the compartments and the engine rooms were inundated and the furnaces submerged. Scarcely had she been righted and her engine rooms pumped out when a gale sprang up which opened her seams and allowed her to fill again. To steady her during the storm and prevent her being driven farther on the rocks, anchors were carried out from the bow and stern on both sides, and the chain of the anchors kept taut by means of steam winches on the deck of the vessel. When the gale subsided, the boat had to be pumped out again and considerable additional patching done. The patches utilized were formed of shields of wood, fitted over the breaks and padded around with canvas and rubber. Some of the shields were as large as the door of a house. The actual releasing of the vessel was accomplished by setting in motion the steam winches connected with the chains of the stern anchors while the three wrecking steamers united simultaneously in a long, steady, pull.

Among the minor salvage operations possessing an unusual degree of interest it would be unjust to pass over the ingenious methods followed in floating the Warren liner Norseman, which went ashore in March, 1899, near Marblehead Neck, Mass. An examination showed that the greatest damage to the vessel was a jagged hole four feet square in the forward portion of the hull. The wreckers battened

down the hatch on the lower deck and then held it tightly in place by a series of shores braced against the upper deck. The water filled the entire hold below the lower deck.

After these preliminary preparations had been made, the pumps, each throwing 2,850 gallons of water per minute, were put to work, pumping water, not out of, but into, the hold of the vessel; as a result, the water poured through the large leak with great force and, striking against the lower deck, assisted in buoying up the vessel. The large hole mentioned was located about 25 ft. from the bow on the starboard side. There were, of course, other holes of smaller dimensions all along the bottom as far aft as the engine room, but they were stopped in the usual manner with canvas and boards.

Although perhaps not generally known, the fact remains that some of the most perfect wrecking plants in the world are to be found on the great lakes of America. The whole equipment of these fresh water salvors is selected with a view to rapid work. The necessity for this is well illustrated by the sinking in St. Mary's River in September, 1899, of the steel steamer Douglass Houghton, one of the largest cargo carriers on the inland seas. Inasmuch as the wreck blocked practically the only deep-water channel between Lakes Huron and Superior the whole commerce of the upper lakes was virtually at a standstill.

Dynamite blasting was resorted to for the removal of the limestone rock into which the vessel had run her nose. A large portion of the vessel's cargo of iron ore also had to be transferred to lighters, as the shallowness of the stream made it impracticable to dump it overboard. The energy manifested, even in the under-water work, is evidenced by the fact that, although the hole in the Houghton's side was 2 ft. fore-and-aft and 7 ft. up-and-down, it was patched temporarily so that in thirty-six hours after she sunk the vessel was enabled to pump the water out of her hold with her own pumps.

EDITORIAL COMMENT

The entire naval-engineering world, on both sides of the Atlantic, has been waiting with great interest the formulation, by the United States navy department, of the rules putting into actual effect the personnel law, which was passed last March. The readjustment to modern conditions of the status of the engineer in the navy is the thing most vitally important to the efficiency of the navies of to-day, and seapower is the most important factor in national ascendancy. THE ENGINEERING MAGAZINE has always advocated most strongly the principle of developing the all-around naval officer—trained both as an engineer and a military man, and capable of serving on deck or the engine-room—as a thoroughly sound one, and one which is absolutely essential to the preservation of naval power.

Attention has only recently been drawn to the fact that, in August last, the assistant secretary of the United States navy issued an order, known as General Order No. 524, ostensibly for the purpose of carrying out the personnel law; but, so far from carrying out its real purpose, this general order carefully provides that the express will of Congress shall be nullified; for it states in one paragraph "it is the Department's intention that, so far as practicable, commissioned officers shall be relieved from engine-room watch."

If this order becomes the established rule in the United States navy, it will be seen at once that the purpose of the personnel bill will be entirely set aside—and, curiously enough, the law will be violated by government officers who are specially charged to enforce it.

The seriousness of this feature, however, for the United States in general, is that it will take away, in a short time, all the wholly trained technical skill from the machinery of the great ships. For a few years, those of the former engineers who will be transferred to the line will be available to act as chief engineers of the ships; but under this system, as now, commissioned officers will be getting no training in engineering. When the former engineers are gone, the navy will simply have the skilled mechanics, who are handicraftsmen, but not engineers in the true sense of the term, directed by a dilettante who knows nothing of engineering from real experience.

It is to be observed that this is the very system which was in vogue in the Spanish navy in time of the late war between the United States and Spain, and the results of such a system have been demonstrated so thoroughly that it is simply amazing any government official should have been willing to father an order calculated to destroy the efficiency of the navy.

The only explanation for it is, that the actual author of this order was Admiral Crowninshield, the chief of the Bureau of Navigation, of the United States navy, who is charged with the routine work of the organization, and

who was notoriously opposed to the personnel bill, having very frankly so expressed himself when a member of the personnel board. It is hard to believe that the assistant secretary ever read this order, and it can only be supposed that it was signed by being shoved in with a lot of other papers which are passed without examination.

Apparently, the people who persuaded Mr. Allen to sign this order have an idea that no one outside of the navy takes any interest in its efficiency. They will no doubt find that the engineering interests of the country, who pay their share of the taxes which build the big ships, propose to see that the machinery is properly cared for. Steps will no doubt be taken, also, to find out whether a plain law of Congress can be violated with impunity by officials whose business it is to carry it out.

* * *

Comment was made in these columns in the November issue, upon the general subject of indexing engineering literature, especial reference being made to such periodical issues as are made by THE ENGINEERING MAGAZINE, *Science Abstracts, Le Mois Scientifique et Industriel,* and other similar publications.

The matter is of sufficient importance to demand further attention, especially in view of the work which is proposed by the Boston Public Library in an allied branch of science. This index, for the present, is limited to the one subject of Physiology, but it is rather of the method than the subject of which mention is now made.

* * *

Ordinarily the index of a science, whether in card or book form, is intended to be a mere guide to the article indexed. In many cases nothing is given but the title and author's name, and as everyone knows, titles are often very doubtful clues to the substance of the articles to which they belong. The result is that the searcher must first consult the index and then send for a number of articles which he may or may not want, but about which he can tell little until he has examined them. The defect has been partially met in the case of the Engineering Index by the addition of a brief note or legend to the title, giving, as far as is possible in the very limited space available, a hint as to the character of the article, and in *Science Abstracts,* and in some other voluminous indexes, an abstract of the entire article is given.

* * *

In the case of the Physiological Index of the Boston Public Library it is proposed to furnish a full abstract of every article indexed upon the index card, these cards being printed and placed on file for consultation in the library, and also to a limited extent held on sale for those desiring to form private indexes. An index of this sort would constitute a classified epitome of the current state of the science to which it relates, and for many, if not most, users it would dispense with further reference to the original articles, while to the closer student, much laborious handling of undesired volumes would be saved. Being in card form, and kept closely up to date, it would be in better shape for general consultation than a book index, while so far as bulk is concerned the difference would not be a serious objection.

The real value of such an index, whether relating to physiology, en-

gineering, or any other branch of science, depends almost altogether upon the skill with which the preparation of the abstracts is made. To boil down the substance of an article of several thousand words to a limited space such as is afforded by an index card, requires two distinct forms of ability, the one being a capacity to absorb the true value of the original, and the other the ability to condense the substance of it into a paragraph or two.

Many men possess one or the other of these faculties, both are rarely found in the same person. Properly executed, such an index, covering all branches of science, would be hailed with enthusiasm by scientific workers all over the world, but the magnitude of the task is one which demands careful thought and cautious investigation lest the attempt fall far short of the conception.

* * *

The annual report of Secretary Long, of the United States navy, has just been issued, and manufacturers will be both surprised and amused to see the secretary's ideas of the way to secure an increased efficiency in the administration of the department. He proposes to consolidate the three largest constructing bureaus, namely, Equipment, Steam Engineering, and Construction, under one head for the alleged reasons of economy and harmony. If Secretary Long knew anything about manufacturing or the conduct of any large business, he would realize the absurdity of this claim, for what will actually occur will be that, instead of three independent heads of the co-ordinate bureaus, each of whom will have a ready access to the head of the department, there will be one head of the co-ordinate bureau, with three assistants who will do the same work as done by the bureau chiefs. As for any reduction in the clerical force, the experience of the entire department would teach exactly to the contrary; for a somewhat similar consolidation on a smaller scale, as we are informed, multiplied the clerical force several times and the amount of red-tape many fold, instead of making any reduction.

The commission of such an economic mistake as consolidating these bureaus on the ground of harmony is simply a confession of weakness. The Secretary of the Navy is really in exactly the position of the general manager of a great railroad or manufacturing corporation; the bureau chiefs correspond to the heads of the departments. If a competent manager found that his heads of department were wrangling, he would not attempt to avoid the difficulty by consolidation of the departments between which there was friction, but by finding the man who caused the friction and by giving him to understand that if his polemic spirit were not curbed, he would have to seek a field of usefulness elsewhere. It is an open secret to those having dealings with the United States navy department that the lack of harmony said to exist has been systematically brought about by one man, or set of men, who were working to give the Secretary this "lack of harmony" as a basis for his scheme of consolidation. We have rarely known of a more melancholy spectacle than that afforded by the head of a great department of a great government confessing his inability to maintain discipline in his own department and running to the legislative body with schemes for relief.

The relation which technical and engineering education bears to the development of the commercial side of engineering is being realized now more strongly than ever before, and some writers go so far as to say that it is upon methods of technical instruction alone that future progress must largely depend. While this is true to some extent, it must be remembered that education cannot create, it can only develop that which is already there.

At the same time there is a disposition among technical instructors to follow instead of to lead, in that they endeavor to provide an instruction based upon the methods of the past rather than to endeavor to consider that much of what has formerly been satisfactory will have to be unlearned. There has been a great clamor for technical instruction which will fit the youth for the workshop, and in the endeavor to meet this demand the conditions of the workshop of the past have been taken as an indication of the kind of instruction which is required. Assuming that machinists can be made in the trade-school, an assumption which many are not prepared to admit, it is a matter of some curiosity as to what these machinists are to do when they are made.

* * *

It is clearly evident that there is a great transformation going on in shop methods, which calls for an entirely different kind of mechanic from that produced either by the old method of apprenticeship or the newer method of the trade school. The nature of this revolution has been clearly shown in Mr. Roland's papers, which are now appearing elsewhere in this Magazine, and for a modern machine shop, fitted largely with modern automatic tools, using all possible appliances for utilizing repetition methods, something altogether different from the ordinary machinist is needed.

* * *

Among the various matters of interest brought to the attention of the members of the American Society of Mechanical Engineers at the recent convention in New York, the movement to erect a memorial to Robert Fulton is especially worthy of mention. The body of Fulton now lies in the Livingston family vault, in Trinity churchyard, New York, but there is no outward indication to guide the visitor to his resting place, and it is this omission which the society seeks to rectify.

There could hardly be a more appropriate location of the tomb of the man to whom the development of steam navigation is due than this quiet spot in the midst of the busiest portion of the metropolis. The greatest steamers of the world ply back and forth in waters of the rivers and harbor within a stone's-throw of the grave, and one might here truly say, as of Wren in St. Paul's, *"Si monumentum requiris, circumspice."* About the quiet churchyard are grouped the buildings in which the business of the great steamship lines is transacted, and from the foot of the street where the monument will be placed is the starting point of some of the swiftest vessels on the bay. Everything is here combined to make the associations join to perpetuate the work to which Robert Fulton devoted his life, and there is no more fitting body to whom the erection of a memorial could be entrusted, than the American Society of Mechanical Engineers.

REVIEW OF THE BRITISH PRESS

The Congestion of City Streets.

THE address of Sir John Wolfe Barry before the Society of Arts, published in a recent issue of the *Journal* of the Society, is devoted to a subject which, while of pressing importance in London, is also becoming a serious one in other great cities. This address reviews the similar one delivered by the author at the last session, and shows how the various points then made have become still more important.

A great portion of the crowding is due to the fact that improved means of transportation have rendered it possible for residents of suburban districts to become daily travellers to and from the heart of the metropolis, and from suburban and Greater London streams of people are constantly passing in and out of the strictly urban portion of the metropolis, thronging the streets, many of which were made when the number of inhabitants was one-fifth or one-sixth of the present total. It is estimated that 960,000 people enter and leave London daily by railways alone, and that the number of roadway vehicles has trebled in the last 27 years. It needs no especial argument to show that traffic has overtaken the means for accommodating it, or that the main lines of arterial communication are intolerably crowded.

One attempt which has been made to obtain a little relief has been the police prohibition of empty cabs moving about in search of fares, but this has apparently only changed the character of such obstruction, since it has led to the establishment of long cab ranks occupying the middle of great thoroughfares already too narrow and too crowded. It is not only the number of vehicles passing which is the measure of the capacity of a street, since there should be sufficient width to permit differences of speed, and to allow vehicles capable of speed to pass the slower ones.

Any attempt at relief in a city like London must necessarily be very expensive, but the real question lies in the cost of not obtaining relief, and hence it is important to find out how much money is being lost by submitting to the present state of affairs, and if such loss can be shown to be greater than the cost of improvements the relief may appear an economy after all.

It is by no means easy to arrive at a fair valuation of the money loss caused by delays to traffic in crowded streets, but the computation in the paper shows that on four of the principal thoroughfares in London each day there are 16,650 omnibuses, 14,900 cabs and carriages, and 9,700 carts and other vehicles impeded and delayed. By a comparison of a number of cases an average delay of 20 per cent. is taken as being fair, and a similar averaging of values gives the mean value of the traffic in these streets as £1,631 per hour, and the loss upon this reaches the total of £880,740 per annum. This applies to vehicular traffic alone, and if to it is added a loss, similarly computed, for Euston Road, the figures for the loss to vehicles alone may safely be put at £900,000, on these streets. The losses at crossings must also be computed, and in addition there is a general loss to trade interests, due to overcrowding and also the delay to pedestrians, and summing all these, the total annual loss to London on the limited area above considered is given as £2,154,000.

While these figures can make no claim to high precision they are undoubtedly within the limits of the truth, and this being the case it can be seen that a large expenditure would be warranted in order to obtain relief. Sir John Wolfe Barry offers some suggestions as to the most available method of obtaining relief, which in his opinion could be attained by the construction of certain subway and viaduct crossings and turnouts, by means of which the most congested spots would be greatly relieved. These can hardly be described without maps, and are not offered as a final solution of the problem, which really demands the opening up of new and wider highways, but the time required for any permanent improvement makes it most desirable to at-

tempt some temporary amelioration of the existing conditions as soon as practicable.

In this connection it should be remembered that a great and immediate relief could be obtained by the general introduction of motor vehicles. It is apparent that at least one-half the space required by a horse-drawn vehicle is saved by the use of the automobile, while the facility of manipulation in turning and backing in a very limited space makes the clearing of blockades a much simpler matter than is possible with horses. With automobile cabs and omnibuses the congested streets of London would be immediately relieved to a very great extent, and in the respite thus gained permanent improvements might be planned and conducted upon the best and most economical lines.

Engineering Progress in England.

PRESIDENTIAL addresses are not always interesting reading, but when an engineer of the eminence of Sir Douglas Fox speaks as its presiding officer before the Institution of Civil Engineers, the remarks may well be expected to contain much that is worthy of thought and review. This is especially the case at the present time when there is such an active discussion of all the problems connected with both the constructive and the commercial side of engineering. As Sir Douglas Fox well remarks, it is only a short time since Great Britain was the workshop of the world and the educator of all the nations in mechanical science. With the development of technical education on the Continent, however, all this has been changed, and much is to be learned from foreign engineers, notably from those of France, Germany, Italy and Switzerland, as well as from Anglo-Saxon America.

The early portion of the address includes a review of the history of engineering in Great Britain, from the work of Murdoch, Telford, the Rennies, and the Stephensons, not to mention other names of the notable list, showing the prominent part which England has taken in the technical progress of the century. Coming then to the active problems of present engineering work, these are taken up and briefly reviewed in succession, the whole forming a comprehensive presentation of the field.

It is only possible in the limited space here available to comment upon the salient features of the address, and the original must be read by those who desire the whole. It must, therefore, be understood the points here discussed have been selected for their timeliness, and do not represent in any degree the scope of the address. A conspicuous feature is the emphasis which, in various portions, is laid upon the repressing influence of state and municipal control of engineering work, particularly in the development of new enterprises. This is apparent in the slow progress which has been made in England in the introduction of electricity, in its three great applications of lighting, traction and the transmission of power.

"Hampered by restrictive legislation, opposed by vested interest, and encumbered by the by-laws and regulations of official bodies without number, the electricians, who form so important a branch of the profession, have been unable to do justice to their skill. A few railways, especially designed for city traffic, and a comparatively insignificant length of electric street tramways, have struggled into existence. Some rather better progress has been made with lighting in the chief towns, but it is discouraging to compare the present position of electrical industries with that of similar undertakings in the United States, Switzerland, Germany, Japan, and even in the British colonies."

Another feature in which progress is retarded in England by local restrictions is fond in connection with the development of water rights, both for water-supply of cities, and for the generation of hydraulic power. While in Great Britain discussions are conducted with reference to the right to carry water from one watershed to another, vast installations are being rapidly established in Germany, Switzerland, and the United States, where difficulties of this kind are readily swept away if found to impede industrial progress. "Mechanical traction upon public roads has been, and still is, most seriously hampered by restrictive legislation in Great Britain, which, with all its enterprise, is very slow to adopt improvements involving any change in the ordinary course of life. Whilst American and foreign engineers have been able to build and run motor cars for a long time

past, it is only quite recently that such carriages have been allowed to travel in England, except with a red flag in front and at a foot's pace. Even under the new act, which has given impetus to this important industry, the limitation of the weight to three tons, instead of four tons, prevents many valuable improvements from being adopted; and by rendering necessary the introduction of aluminum and other costly materials, has kept the price of such carriages at a prohibitive figure for general use."

"The question of the congestion of traffic in London alone, renders it advisable to consider the importance of the motor vehicle as a means of relief, and we may look forward to the time when horses shall have given way, in towns at least, to mechanical traction, avoiding offensive smell, reducing noise, and wear and tear, and enabling asphalt pavement to be used throughout with cleanliness and safety."

These are but few of the current engineering problems in which British engineers have been compelled to see themselves distanced by their professional brethren in other countries through no fault of their own, but solely because of the peculiar local difficulties with which they have had to contend. While the restrictions are gradually being removed or modified their effect cannot fail to constitute a serious handicap by reason of the great start which has been given to energetic and industrious competitors.

There are many other portions of the address which are filled with interest for the profession and for the world at large, but it is by its serious warnings of the above nature that it is chiefly characterised, and coming from such a source, delivered to such an audience, these significant utterances should meet with prompt and effective recognition.

The Electrical Distribution of Power.

THE introduction of electric driving into machine works is a question meeting with much discussion at the present time, and the paper of Mr. John S. Raworth before the Manchester Association of Engineers brings out some points in connection with the practical working of electric distribution of power which are of interest.

In some lines of work the advantages of electric driving are so obvious that no discussion is necessary; such a case is found in a shipyard, where many isolated tools are spread over a large area. In other cases, as in various engineering establishments, the convenience of electric power is evident, but the question of the economical advantage of making an expensive change requires consideration. When we come to the work of the cotton spinner and manufacturer, where everything can generally be arranged so as to permit mechanical driving to the best advantage, it is difficult to show how electric driving can be substituted to financial advantage.

The subject is necessarily bound up with that of the cost and efficiency of the motors. A comparison of prices of motors by reliable makers shows that the price for motors is naturally proportionally greater for the smaller sizes than for the larger, so that an extreme subdivision of power, using small motors for every machine, involves a much greater first cost than is required for a single motor of the capacity of all the small ones. As a matter of fact it is not necessary to have power enough in a single motor to drive all the tools in a workshop at one time, as a portion are always standing, while with independent motors, capacity must be provided for all, since no motor can drive any but its own machine.

So far as efficiency is concerned, it must be remembered that mechanical and commercial efficiency are by no means the same thing, and a plant with a high mechanical efficiency may involve such charges for interest, depreciation, superintendence, wear and tear, etc., as to render it less efficient commercially than one less complete technically.

The true method of attaining high commercial efficiency with electric driving lies in the establishment of large generating stations, enabling the fixed charges to be reduced to a minimum, and supplying power to a number of consumers at as low a price as the use of large-scale efficient machinery will permit. The observation of Swiss methods made by Mr. Raworth, during the recent visit of the Institution of Electrical Engineers, caused him to state that he believes that all the Swiss factories will be electrically driven within ten years. This,

however, is in a land of cheap water-power and dear coal, but in England it is possible to generate cheap electricity with large plants using steam power.

Mr. Raworth gives an estimate for a plant of 50,000 horse power in which he shows that the yearly cost may be taken at about £2 per horse power for factory hours, or double that for continuous service, but at the present time the price for supply by corporations is more than double these rates.

The advantages of electric driving in machine works amount to much more than any direct economy which can be taken from the cost of the power, and the increased efficiency of the plant as a whole, due to convenience of handling, possible better arrangement of tools, and general increased output, must be taken into account in making an intelligent comparison. The one item of better arrangement of machinery will appeal to every works manager who has found himself hampered in placing machinery by considerations involving the getting of the motive power to the tool, and the ease with which valuable space can be utilised to best advantage is a matter well worthy of consideration. Probably the change will come about by the gradual introduction of group driving in the older works, and complete independent driving in the newer establishments, and as the development of central supply stations reduces the cost of generation the commercial advantages will become more and more apparent.

Mr. Raworth's paper contains a valuable appendix compiled from a number of sources, giving the power required for various machine tools, and while this is intended to serve as a guide for the selection of motors for separate driving, it will doubtless be found useful in other connections.

The Cost of Steam Raising.

In all modern manufacturing operations the cost of the power required is a matter of constantly increasing importance, and the interest which is taken in this element of manufacturing cost is shown by the number of papers devoted to the cost of power presented before the various engineering societies. The cost of steam power has especially been given consideration since the revival of water-power development for electrical purposes has brought about a competition which was formerly not in existence, and to electrical engineers the questions involved are of much importance.

The cost of steam raising has recently been discussed very fully in a paper by Mr. John Holliday, presented before the Institution of Electrical Engineers, and from this paper some abstracts are made.

We may practically consider the fuel as the raw material and the steam as the manufactured product, the other elements of cost in a properly managed plant usually being a small proportion as compared with the coal. It is only in the centre of the coal fields, or in some other equally favoured spot that the cost of the coal will be anything less than 50 per cent. of the whole, the exceptions mainly being such instances in which waste materials and by-products are used; and even in these cases the cost of handling and transport often serves to render the economy of such fuels problematical.

The fuel question often comes down to a comparison between the real economy between high-class and inferior coals, and several points are to be considered in making such a comparison. From a purely theoretical standpoint the inferior fuel should be the more economical, since the difference in cost more than counterbalances the lower heating value. As a matter of fact the practical advantage is generally with the cheaper fuel, but as there are always some losses which partially offset expected gains, it is important to examine the disadvantages which attend the use of inferior fuel.

"In the first place, in order to get the same amount of heat with a low-quality fuel as with a higher quality under similar conditions, more fuel must be burned in the same time; then, if the boilers and furnaces are already working up to their full power, either more boilers and furnaces must be put down, or the present furnaces must be enlarged, entailing an expenditure of capital, the interest of which must be set against the extra economy attained; or else the fires must be worked harder, perhaps by the use of forced draught, causing

the furnace gases to leave at a higher temperature, and thus carry to waste a larger portion of the heat in the fuel than formerly. The mere fact of more fuel having to be fired into the furnaces every hour will entail more work upon the stoker, for which extra wages will have to be paid, either to the same or to additional men. The extra amount of fuel used will cause the fire doors to be opened, in the case of hand-fired furnaces, more frequently or for longer periods, both for firing and for cleaning fires, whilst the extra amount of refuse taken from the furnaces will carry to waste a correspondingly larger amount of heat, and, what is more important, will often cost a great deal more in removal, particularly in busy manufacturing centres. Extra storage and space for fuel may have to be provided, and the wear and tear of the furnaces increased according to the extra amount of steam used, and not according to the amount of steam produced. Low-quality fuels, too, as a rule, require a stronger draught to burn them to the best advantage than better qualities; this may necessitate an expenditure for more chimney power in the case of natural draught, and larger fans and engines, using more steam to drive them, in the case of forced draughts."

"In substituting inferior for better class fuels we may expect a reduction in the cost of the fuel, depending on the differences in the ratio of calorific value to price of the two fuels, and an increase in working expenses, etc., depending on the increased amount of fuel used."

As an example of how all this works out in practice Mr. Holliday gives some interesting data concerning a battery of Lancashire boilers in which he is interested, and gives in tabulated form the results with different fuels and methods of firing. Out of nine boilers, three are fitted with Perret grates for burning breeze, while the others have ordinary bars and are hand fired.

The details of the trials are given in the paper, and experience showed that with breeze at 3s. 6d. per ton and Welsh coal of good quality at 14s. 6d. per ton, the cost of evaporating 1,000 gallons of water was more than two and one-half times greater with the Welsh coal than with the breeze.

An important portion of the paper is a tabular analysis of the distribution of all the costs of steam raising, including boilers fired with breeze and using forced draught, boilers fired with coal and using natural draught, and spare boilers worked under less favourable conditions than the other batteries. In this table it appears that with the forced draught the cost of evaporating 1,000 gallons of water was 7s. 3.54d., as compared with 9s. 2.12d. for the natural draught, although the latter were evaporating proportionally a greater quantity of water. In the case of the forced draught boilers, the fuel cost formed only 43 per cent. of the whole, while for the natural draught the fuel was 73 per cent. of the cost, this showing clearly the greater proportion which the handling and fixed charges bear to the fuel in the case of the cheaper material. These charges include working expenses, such as wages, handling, lighting, etc., maintenance, insurance, interest, depreciation, taxes, and superintendence, and the tabulated form given should form a very interesting study to all interested in steam making.

American Competition Again.

THE series of papers by eminent English and American authorities in engineering, which was reviewed while yet in progress last month, has been continued with able contributions from Mr. G. N. Barnes, the secretary to the Amalgamated Society of Engineers; from Mr. Oberlin Smith, a well-known American manufacturer, and past-president of the American Society of Mechanical Engineers, and from Mr. Archibald P. Head, the latter certainly well familiar with engineering and commercial work on both sides of the Atlantic.

As might have been expected, the correspondence columns of *Engineering* contain many communications upon various phases of this many-sided subject, and the whole is of sufficient interest at the present time to warrant further notice.

Some excellent points are brought out in the correspondence, among them being one to the effect that both Great Britain and the United States are at the present time in an abnormal condition as regards the demand for the products of industry, and that as this demand set in a little later in

the United States than in England, it is but natural that certain British orders should be filled by American manufacturers.

The question of standardisation has also attracted much attention, and while its immediate commercial advantages are conceded, its ultimate influence in lowering the individual status of the workman is pointed out.

The contribution of Mr. Barnes to the symposium is a matter of especial interest, not only from the fact of his position as the representative of organised labour, but also because some of the views expressed by him have been disowned by members of the A. S. E., and as strongly indorsed by well-known employers of labour. Mr. Barnes admits the advantages of specialisation, and agrees that British conservatism has kept tools and methods in use which have practically been abandoned in America. At the same time he maintains that in the present demand for the products of the machine works England is getting fully her share of the orders, and sees no cause for alarm. So far as the retention of old-time tools and methods is concerned, Mr. Barnes very truly points out that unions cannot be held responsible for this state of affairs, since these conditions also obtain in industries in which no unions exist.

Mr. Oberlin Smith maintains that the primal underlying cause of success in America is due to the fact that the people are mostly descended from Englishmen, and that the English character is stimulated by the new environment. While the literal exactness of this statement may be questioned, there seems to be little doubt that the greater number of those Americans who have been active in the development of manufacturing and mechanical industries in the new world have been of British descent. It is a matter of observation that the modifications produced in native born Britons by the struggle to develop colonial success have resulted in the formation of individual characteristics closely resembling the more enterprising class of Americans. Mr. Smith calls attention to the fact that it is mainly in the smaller things, such as watches, pistols, sewing machines, light machine tools, etc., that American competition has been most successful, England holding her own in the case of ships, and similar large work, the locomotive and bridge cases, about which so much has been said, really being exceptions, and the hint is made that American methods are furnishing object lessons to other nations, the learning of which will soon help to equalise matters. Mr. Head carries the matter further than does Mr. Oberlin Smith, and while conceding that small products have been sent to England from America for many years, says that the competition with heavy work has now begun.

In examining the historical side of the question, it is shown that the commercial and manufacturing supremacy of England may be dated from the close of the Napoleonic wars, when the industrial progress consequent on the invention of the steam engine, began to develop. During the succeeding 60 years England came to regard herself as the workshop of the world, and being practically without competition, she considered this the normal condition of affairs. The last 20 years, however, have seen the development of American and Continental competition, and the question remains as to whether this competition may not be of the nature of an equalisation.

Mr. Head sees this fact clearly and meets it squarely, without attempt at evasion. After noting the conditions of labour, transport, and living, as existing in the United States, together with the competitive advantages gained by the powerful commercial organisations now so prevalent, he goes on to face the question as to what can be done to regain England's old position in the industrial world. "The English people will probably never do that, and will have to be content with a share of the world's commerce. But much can doubtless be done to prevent further retrogression, whether relative or actual. The conservatism of Englishmen must be broken down, and they must be content to learn from their American cousins."

That all this means only a friendly rivalry is clearly seen, and the key note of the discussion in this respect is not unsatisfactory, since it indicates a competition, which means, not industrial warfare, but rather association for the development of those qualities which shall make the Anglo-Saxon industrial supremacy assured throughout the world.

Review of the Continental Press

The Charlottenburg Centennial.

The recent celebration of the one hundredth anniversary of the founding of the Royal Technical High School at Charlottenburg, near Berlin, calls attention to that important institution; and the great influance which its work has exerted upon technical education as well as engineering practice renders it desirable to give some notice of the event and the institution which it concerns.

Technical instruction, in the modern sense of the term, appears to have originated in Prussia during the closing years of the reign of Frederick the Great, and in an account of the growth of the present Technical High School given in the *Zeitschrift des Vereines deutscher Ingenieure* some interesting and amusing facts appear about organization of the military engineering school from which the institution descended.

The present school was formed from the union of two institutions, the Bauakademie and the Gewerbeakademie, and it is from the foundation of the former, in October, 1799, that the recent anniversary is computed. The older institution, as its name indicates, was mainly devoted to instruction in architecture and building construction, and numbered among its first professors the name of Eytelwein, who subsequently became its Director. The work of the Bauakademie gradually extended into the field of civil engineering, especially in relation to surveying, and the details of civil construction.

Meanwhile the Gewerbeakademie, under the able direction of Wilhelm Beuth, had been established, this institution being devoted to instruction more strictly technical in its character. In addition to a general foundation in mathematics and general physics, the courses included studies in mechanics, applied chemistry, industrial technology, and a certain amount of manual training. Among the instructors we find such well-known names as Wedding, Brix, Dove, Grashof, and later Reuleaux, Slaby, Wagner, Riedler, and others.

As might be expected, much of the work done by the two institutions was in a common field, and in the rapid development which came to both after the formation of the empire in 1870 it became evident that there would be much advantage in union. In 1879, therefore, the two older institutions were merged into one, under the name of the Berlin Technical High School. The increasing numbers of students, and the general demand for better accommodations soon led to the undertaking of new buildings, and in 1884 the present magnificent buildings at Charlottenburg were dedicated. Even these quarters are now become too limited; originally planned for 2,000 students, they are now compelled to serve for more than 3,400.

The influence of this institution on engineering and technology in Germany has been very profound, and to its work much of the rapid advance which has been made in the industrial development of the empire is undoubtedly due.

The celebration of the centennial anniversary was conducted with much enthusiasm, the Emperor delivering an address in which among other things he referred to the remarks of his grandfather, the Emperor William I., upon the occasion of the formation, fifteen years before, of the present institution by the union of the two older ones.

The Emperor also announced that hereafter the institution would have the authority to grant the doctor's degree, both honorary and in course, thus raising it to the level of a university and showing very clearly the revolution which has been wrought in Germany, so far as the relative standing of the two classes of institutions is concerned.

The most notable feature of the celebration was the unveiling of the two fine bronze statues of Werner von Siemens, and Alfred Krupp, these being placed in the grounds before the buildings of the High School, and fitly representing the embodiment of applied science in the persons of two of its foremost representatives.

The attendance at the celebration of representatives of most of the greater German universities showed the standing to which a technical school has attained in the esteem of the older institutions; and those countries which still discern in their own educational institutions a tendency toward discrimination by the advocates of the older learning against the newer education, may well take note of the harmony which exists in Germany.

The influence which a practical technical education has upon the material development of a nation may well be learned by example; excessive conservatism in educational matters has sometimes retarded national progress to as great an extent as has unprogressiveness in other more conspicuous directions.

It is the men who know how to do things, and who look and think, and act for the future, who make for progress; while those who devote their thoughts and studies to nothing but the past, however good their work, are only contributors to our knowledge of what has been done, a knowledge which, however interesting, makes but indirectly, if at all, for the progress which should be our high aim.

Space Telegraphy in the Alps.

NEARLY all the experiments with space telegraphy which have hitherto been made public have been conducted at or near the sea level, being made between the shore and a vessel or lighthouse, or between one vessel and another. We now have a communication to the French Academy giving the results of the experiments of MM. Jean and Louis Lecarme communicating between Chamonix and the summit of Mont Blanc, and from the note in *Comptes Rendus* some account of these interesting trials is abstracted.

The horizontal distance between the stations in these experiments was not great, being only 12 kilometres (about 7½ miles), but the difference in altitude is very great, Chamonix being about 1,000 metres above the level of the sea, and the height of the Vallot observatory, near the summit, being 4,350 metres, a difference of 3,350 metres (about 11,000 feet). The rock between the two stations consists entirely of mica schist, the upper portion being entirely covered with ice, and the lower part with alluvium and glacial moraines.

The original intention of the experimenters was to solve the following questions in connection with space telegraphy, namely: 1. Whether space telegraphy is practically possible in mountainous regions; 2. If atmospheric electricity would interfere with the communication; 3. Whether the absence of moisture from the ground would have any influence upon the result; 4. What influence would be produced by distant storms?

The apparatus used possessed no especial peculiarities. The transmitter had a normal sparking length of 18 centimetres, which was reduced to 2 centimetres when the communication was made between the ground and the terminals on the pole. The latter was 25 metres in length, extending into the air at an angle of 30°.

The receiver, situated in the Vallot observatory at the summit, consisted of a very sensitive coherer filled with gold filings, this having been furnished for the especial purpose by M. Branly, and a dry battery, telegraphic relay, and tapper. The latter was so constructed as to interrupt the current automatically before tapping, this arrangement permitting a very light tap to suffice for decohering, thus maintaining the sensitiveness of the coherer very nearly uniform during the whole of the experiments.

According to the summary of results given in the paper, the difference in altitude did not seem to interfere with communication, but when the distance between the balls of the oscillator was less than 2 centimetres the signals were not always clear. The condition of the soil and of the atmosphere produced no effect, there appearing to be no interference due to the frozen condition of the ground, or to the presence of clouds and fog between the stations.

The influence of atmospheric electricity appeared only by causing action in the receiver, but apparently this did not interfere during the transmission of messages.

The most important result of the investigation, apart from the demonstration of the success through great differences in altitude, was in an unexpected direction. It was found that the operation of the electric lighting plant of Chamonix produced a powerful effect upon the apparatus, so

much so that it was impossible to maintain communication between the stations during the hours when the lights were in service. The lighting system there in use is operated by a three-phase current of 2,500 volts pressure, but as the circuit is closed upon itself, without the formation of sparks, it seems as if the coherer is sensitive to other influences besides that of a direct discharge. While this action has as yet not been further investigated, it is possible that it may lead to the introduction of some other form of transmitter than that using the high tension discharge.

The Study of Fuels by X Rays.

ALTHOUGH the earliest practical applications of Professor Roentgen's discovery were in the domain of surgery, other uses outside of the physical laboratory are gradually being developed.

Among these is the application of radiography to the examination of coals, and from an article by Herr F. Kotte in *Stahl und Eisen* the following abstract is made:

It is well known that the rays do not pass through all materials with equal facility, and that there are some substances which offer a marked opacity to them. Both wood and crystallised carbon in the form of diamond, are practically transparent to the X rays, and, as might be expected, the various forms of carbonised wood are also readily traversed. When, in addition it is understood that the usual impurities in coal, such as slate and pyrites, are practically opaque to the rays, it will be seen that radiography offers a means of detecting the non-combustible in a piece of coal without necessity of the destruction of the specimen.

Herr Kotte refers to the earliest researches in this line of investigation by Dr. Thorner in 1897, but the latest work in this line has been done by Professor Couriot at the Ecole Centrale, in Paris, and the radiographs made by the latter of specimens of peat, lignite, and various kinds of soft and hard coal show very clearly the manner in which the presence of slate and other impurities can be determined.

Examinations of pieces in the lump can only be of a qualitative character, but a method devised by the author and by Dr. Aulich enables quantitative results to be obtained. For this purpose the sample must be ground to powder and a layer of standard thickness examined by X rays in comparison with a standard scale of comparison. The degree of opacity may then be made a measure of the impurity, and while the exact nature of the impurity cannot be obtained, the percentage of non-combustible can be measured with some degree of accuracy, although the method can only be regarded as an approximate one at the present time.

Herr Kotte's paper is accompanied with excellent reproductions of radiographs of various specimens, and further study in the application of the method may result in a greater degree of precision in its use.

The Steam Omnibus in Paris.

ALTHOUGH automobile vehicles have found a more rapid and general application in Paris than in any other city, yet the traction of omnibuses and tramway cars there is yet mostly performed by horses. This fact is mainly due to the objections which have prevented the introduction of overhead trolley wires, and to the expense accompanying underground traction or the use of accumulators.

The development of the steam automobile, however, has suggested the use of this motive power for tramway and omnibus service, and in a recent paper by M. G Mauclère in the *Revue Générale des Chemins de Fer,* an account is given of the vehicles now operated by the Compagnie Générale des Omnibus, using the Serpollet system of steam motive power.

M. Mauclère begins by giving a detailed description of the existing horse vehicles, the approved types, of which he gives drawings, bearing the dates 1874 and 1878, the latest of these having 21 places in the interior, 6 on the platform, and 24 on the imperial on the roof.

These vehicles are still in use on most of the lines, but on the routes St. Ouen-Bastille and Ivry-les Halles, the new steam vehicles have been placed.

The principal characteristics of the new omnibuses lie in the steam generator, which is of the well-known instantaneous type with which the name of M. Serpollet is associated. For this particular service the generator is arranged to be contained in a

rectangular case lined with fire brick, the apparatus consisting of several varieties of the peculiar tubes used in this form of generator.

Above the grate there are placed three horizontal rows of tubes, the lower ones being cylindrical, with interior mandrels, leaving an annular space of but four millimetres in width for water, while above these are two rows of tubes of inverted U section, the water space in these being of the same width. In the chamber back of the fire-box there is a group of tubes, the first portion of which is composed of the annular tubes, behind which are some of the U section, and in the rear a double row of grouped tubes without contracted section, these latter being intended as collectors for the steam formed in the instantaneous generators. The whole consists of thirty-two elements connected by wrought-iron bends secured by forged nut collars, the connections being protected from the direct action of the fire. The whole boiler is contained in a space of 69 inches long, 38½ inches wide, and 49 inches high, and is placed in an enclosed space forming a portion of the front platform. The cylinders of the engine are placed in a sheet-iron case beneath the platform, the cranks being on an intermediate shaft carrying pinions engaging with gear wheels on the front shaft of the vehicle. Power is transmitted to the rear axle by chain gearing, so that both axles are driven by the one motor. The framework is built up of plate-iron and rolled sections, thus forming a very substantial base for the motive portion as well as a support for the body of the vehicle.

Apart from the general design of the omnibus, a few words may be given to the operation of the steam generator. As it is constructed to contain no water for a longer period than is necessary for the most rapid evaporation into steam, provision must be made for a feed supply in close proportion to the rate of evaporation, and as a continuous evaporation must be secured in order to maintain the pressure, the feed is arranged to be regulated by the variations in steam pressure. Two pumps are provided, one operated by hand, and used only when first starting the boiler, the other operated by power, and regulated automatically by the pressure. If, therefore, the fire is maintained, the pressure will control the injection of water into the highly heated tubes, and the very small capacity of these as compared with their heating surface will cause the water to be evaporated almost instantaneously, the generation of steam thus proceeding in proportion to the demands of the engine.

Boilers of this type have operated very successfully in connection with the steam automobiles bearing the name of M. Serpollet, and the advantage of avoiding the carrying of a boiler containing a large bulk of water is apparent for such service. Experience has demonstrated that the automatic regulation of the feed water is entirely practicable, and the number of vehicles now in operation is evidence that steam has not yet been crowded out of this field by either the electric or the internal combustion motor.

The Vibration of Ships.

THE subject of the vibrations which occur in large and high-speed steamships has attracted increasing attention of late, and in the efforts to reduce such vibrations some very interesting investigations have been made. Most of these studies have had their origin in the application of the ingenious apparatus devised by Herr Otto Schlick, and described by him in a paper read at the Marine Congress at the Chicago Exposition in 1893. This apparatus, which consists of pendulums so arranged that the vertical and horizontal vibrations of a vessel are recorded upon a paper-covered drum, together with a series of second marks produced by clockwork, has done much to develop improvements in the method of balancing the reciprocating parts of marine engines.

As a result of the latest investigations upon this subject there appears a paper by naval constructor Berling in the *Zeitschrift des Vereines deutscher Ingenieure*, giving the results of experiments upon vessels of recent construction, together with some valuable deductions.

In considering the vibrations of vessels it must be remembered that a ship behaves in a similar manner to any elastic rod subjected to the action of disturbing forces.

these latter tending to produce compression, extension, torsion, and bending, and that, within the limits of elasticity, the deformations are directly proportional to the forces by which they are produced. Since the hull of a ship, like any vibrating rod, has its normal period of vibration, due to its length and disposition of weight, it follows that the vibrations will be greatest in amplitude when the number of reciprocations of the moving masses approaches closely to the vibration period of the ship in a given unit of time. These vibrations may be of three different kinds: longitudinal, caused by compression and extension in the direction of the axis; transverse, due to bending action; and torsional, caused by the various twisting forces. The longitudinal vibrations are the least important of the three, and as the recording apparatus is not arranged to indicate motion in this direction these are not discussed; but the records of the horizontal and vertical motions at various points of a ship enable the transverse and torsional vibrations to be examined, both as regards period and magnitude.

The magnitude of these vibrations is much smaller than is generally supposed, being in ordinary cases only from 1 to 3 millimetres in amplitude. In one case noted by Herr Berling, however, the transverse vibrations reached 114 per minute, with an amplitude of 7 millimetres amidships and 21 to 24 millimetres at the ends, an action which was greatly reduced by a change in the pitch of the propeller.

Tests made with the recording apparatus at various points in a ship show that the hull is like a vibrating rod not only in having a definite time-period of vibration, but also in having nodes, or points of no vibration, and loops, or points of maximum vibration. These points being determined, it is evidently desirable that the machinery to which so much of the vibration is due, should be placed at one of the nodes, although, for constructive reasons, this is often impracticable.

So far as torsional vibration is concerned, there is usually little difficulty, since it is possible to make the hull very stiff in this direction, and modern designs are usually amply strong in this respect. The cause for such vibration is found in the twisting effort of the engines upon the propeller shaft, the rolling motion produced upon the ship at the section where the engines are placed being transmitted fore and aft in the form of vibrations. In the case of the loss of a propeller blade, an accident by no means uncommon, the unbalanced condition of the remaining portion adds much to the tremor, and sufficient rigidity to meet such an emergency should always be provided.

Although it is at present impossible altogether to prevent the production of vibrations, yet some of the efforts which have been made in this direction have shown the way to reduce very greatly the source of the most serious motion, *i. e.*, the action of the reciprocating masses of the engines. This subject, which is dealt with to some extent by Herr Berling, has been developed largely by the researches of Naval Constructor Taylor, of the United States Navy, and by Herr Otto Schlick of the German Navy, and the application of the arrangement of reciprocating parts indicated by them has been introduced into many large vessels, both in the navy and in the merchant marine. This method involves the determination, in a four-crank engine, of such crank angles as will cause the vibrations to oppose, and to a great extent neutralise each other, and in practice it has given excellent results, as the diagrams show.

In many cases vibrations may be materially reduced by a slight change in the number of revolutions of the engines, as the synchronism between the period of the machinery and that of the hull is thereby avoided. By changing the pitch or size of the propellers, a change in the speed of the engines is made practicable, and very often a great improvement may thus be made.

Doubtless the ideal method of avoiding vibrations from the steam machinery is the removal of all reciprocating motion, and in vessels of moderate size, at least, this may be accomplished by the use of the steam turbine. This involves the most careful balancing of all high-speed rotating parts, but the experience which has been had in this branch of applied mechanics in other lines should render accurate running balances entirely practicable, in which case the problem of vibrations so far as the

engines are concerned, may be considered as solved.

Vertical Engines.

THE general adoption of the vertical form for steam engines of large size is a matter which is well known, and indeed it is to the advantages of this form that a portion of the advance in steam engine economy during recent years has been attributed. The use of the vertical form, however, includes a number of problems, especially in connection with the framing and supports, which with the horizontal type practically took care of themselves, and hence a paper by Professor P. Straube, in a recent issue of the *Zeitschrift des Vereines deutscher Ingenieure*, dealing with this phase of the subject, is very timely.

For small vertical engines the usual cast iron column has shown itself to be well adapted, but for the large engines demanded by modern mill and power-house practice a built-up framework is necessary. In view of the general similarity in arrangement of working parts, many designers have simply adopted the precedents of marine engine practice, but experience has shown that the conditions are not altogether identical. In many cases opportunity is offered on shipboard for the bracing of the upper portion of the engine to the framing of the vessel, and twin-screw engines can be braced to each other, while in stationary practice the whole machine stands free and isolated.

Professor Straube first reviews the usual methods of framing vertical engines, and then takes up the actual nature of the forces to be resisted, both as to magnitude and direction, and shows how various designs may be made which will to a great extent meet and resist the stresses to advantage.

The ordinary framing, while well adapted to meet the vertical stresses due to the action of the reciprocating parts, is not always so well suited to withstand the lateral stresses caused by the action of the crank, connecting-rod and rotating masses. Some of these stresses are transmitted to the main shaft bearings, and as these are well supported in the lower portion of the engine, in close proximity to the foundation, they can be well met. Other forces are transmitted to the guides through the cross-head, and the manner in which the guides are supported therefore becomes a matter for careful consideration, while the point of attachment of the cylinder to the framing must always be regarded as a portion of the engine entering very critically into its stability.

When the framing is made wholly of cast iron a form somewhat like that adopted for heavy steam hammers has been used, but this does not permit ready accessibility to the moving parts, and in most instances but one side of the upright framing is made of a casting, this being used to carry the guides, while the other side of the cylinder is supported by wrought-iron rods. This construction, however, does not possess great lateral stability, and hence a number of arrangements are shown which enable diagonal bracing to be introduced, and some excellent forms of framing are given in which the cast-iron upright is omitted and the support composed wholly of wrought iron or steel rods, the inclined rods being firmly bolted to the base plate and to the cylinder with diagonals extending from the guides to the points of support above and below.

An important feature in this connection is the direction of rotation of the shaft. It is well known in horizontal-engine practice that when the engine runs "over" the pressure is downward on the guides, while when the engine runs "under" there is an upward lift. A similar action occurs in vertical engines, and as there is no especial resistance to either side by the base, the vertical framing should be so arranged as to meet the pressure upon the guides in the direction determined by the direction of rotation of the crank shaft.

In view of the extending use of vertical engines an examination of Herr Straube's paper by those engaged in engine design may be productive of more intelligent examples of frame construction than some which have been obtained by imitation of engines designed for an altogether different kind of service.

REVIEW OF THE AMERICAN PRESS

The Education of Machinists.

ONE of the most important papers presented before the recent convention of the American Society of Mechanical Engineers was that of Mr. M. P. Higgins, discussing the education of machinists, foremen, and mechanical engineers, viewed in the light of the writer's long and successful experience at the Worcester Polytechnic Institute.

It seems to be a generally accepted fact that the existing methods of practical technical education are not altogether satisfactory. The technical school turns out theoretical trained engineers, but is able to give only such a degree of practical shop work as will enable the student to have some very general ideas of the methods of actual work. The manual training school aims to train only the hand and the eye, and to give skill in the use of tools without attempting that scientific foundation for which no time is left.

Mr. Higgins proposes to answer the question: "How can we give our boys a chance to learn a *trade* without being deprived of a good common-school education and at the same time secure a foundation upon which to build a higher education if capacity and circumstances permit?"

He finds the answer in what he calls a "half-time school"; one in which a first-class machine shop is operated in connection with an academic department, half the time in a four years' course being spent in each department, the two courses being carried along in parallel, the time in each week being divided between them.

The paper elaborates upon the details of this idea, discussing the distribution of hours, the character of studies, and other matters of practical operation, based upon the experience at Worcester, but the key note of the whole paper lies in the idea that the training is to be given in an actual working shop, partly manned by regular mechanics, and making its products for the open market.

The interest which exists in the subject was clearly shown by the vigorous and effective discussion which the paper elicited from the members of the society. Rear Admiral Melville found the paper most stimulating to thought, but he was of opinion that it would be found impracticable to operate such educational works in competition with regular commercial establishments, and considered the best plan to be that of giving the boy as good an education as could be done up to the age of sixteen, making mathematics the leading subject, and then apprenticing him to the regular trade he elects to follow. Professor Hutton, on the contrary, thought the proposed method most excellent, and apparently saw no obstacle to the practical execution of the idea.

An excellent discussion presented by Professor Thurston gave a symposium of the views of a number of practical instructors consulted by him, and as might be expected, these included a wide variety of views. One of these, especially, appears to have struck the true key note of the situation, namely, the transformation which is now rapidly proceeding in the machinist's trade, a matter which appears to have been overlooked in the original paper. This was the opinion of Professor Kimball, who among other things, said:

"I do not believe that the manual skill required of the machinist is as high as that of thirty years ago. While some of the machines we now build are more complicated than any of that period, the tools furnished the workman are vastly superior to those in use at that time, so that the various portions of a complicated and delicate machine can be made more cheaply and easily and with less skill of the operator.

"For the same reason we have nearly obtained control of the world's markets. It is not so much the good management of our shops that has enabled us to do this, but it is the result of our great advance in machine-tool construction, whereby a man of little skill can turn out fine work in great quantities (turret-tools for example)."

As a matter of fact it is well known among managers of machine works that the best machinists do not always make the best foremen, and indeed there are some good reasons why they should not. The function of the foreman is executive, and while he should certainly be fairly well familiar with the details of the work of the men in his charge, it is the executive ability which is required to make his work successful. The best dramatic and musical critics are never drawn from the ranks of actors and performers, and indeed the opinions of these latter about their own work are notoriously defective.

So in the machine shop, the skilled mechanic who is made foreman usually wastes much of his time doing machinist's work himself, not because he wants to do so, but because he knows of no other way to get it done. The ability to direct and use men to the best advantage is a special talent, and one which is not apt to be developed by a close training of shop detail, but is rather found to result from a broad general training and a wider contact with men and methods than can possibly be acquired within the walls of any shop, however good.

The machine shop of the immediate future will contain a few highly skilled tool makers, specialized instrument makers, so to speak, caring for a shop full of special automatic tools tended by unskilled labor, the whole being under the supervision of an executive who must know men rather than machines, and who must be prepared to call for the technical skill of a few trained engineers to supply his own lack of manual training. For such a shop the technical school may be able to supply the men who make the tools and care for the machines, but these will be few in number. The machine tenders will require no shop experience, their work being limited to the mere starting and stopping, and the keeping the automatic machines supplied with material, and no trade school is needed to to supply such, while the engineers who design the tools and adapt the work to be produced by such automatic processes must come from the highest technical schools which can be had.

It must not be forgotten that the whole old-time machine shop, with its apprentices, journeymen, foremen, and the rest, is to a large extent a relic of mediævalism, bound to be supplanted by altogether different methods, as different from those which the trade school can teach as was the work of Gutenberg's press from the hand-work of the penman-monk who preceded him, and to agitate now any method of training general skilled machinists is as tardy as it would have been to endeavor to encourage the art of engrossing and illuminating when the printing press was already sweeping aside forever such primitive methods.

It is too late now to discuss any plans for manufacturing machinists by any process, however plausible; the turret lathe has supplanted the lathe-hand, the grinding machine the bench-fitter, while tools for handling, conveying, manipulating in every way have taken the place of nearly every kind of skill except the very highest and the very lowest, and the product of the training school cannot become the first and does not need his training to become the second. What he is to do is the great problem of the future, and this problem must be solved before any system of fitting him for it can be evolved.

The Equipment of a Railway Terminal.

THERE has probably been given no such conclusive evidence of the widening scope of the work of the mechanical engineer, as appears in the very full description of the mechanical equipment of the New South Station at Boston, Mass., contributed to the transactions of the American Society of Mechanical Engineers, by Mr. Walter C. Kerr.

Although this paper bears the name of Mr. Kerr, and was presented by him in person, yet he was most careful to state that the various portions of it were prepared by those engineers who had been respectively associated with the different sections of the work, the whole thus having a completeness not possible had it been produced by a single individual.

Although electricity is largely used in the various portions of this great plant, yet the electrical equipment forms but a small proportion of the entire work, and the whole is really what it has been termed by the authors of the paper, a mechanical plant.

Since this important paper fills more than a hundred closely printed pages, besides numerous illustrations, it is evident that any attempt to make a full abstract in the limited space here available is impossible. There are certain features, however, both in connection with the work and with methods by which it was executed, which call for interested comment.

The scope of the work will be realized when it is understood that the station is intended to accommodate 750 trains per day, and that the mechanical installation included the following items:

1. The complete installation of an electro-pneumatic system of switching and signalling.
2. A comprehensive power-house equipment.
3. An extensive electric wiring installation for arc and incandescent lighting, and for electric power for various uses.
4. Passenger and freight elevators, baggage and express lifts.
5. Apparatus for warming and ventilating the head house, and heating yard and express buildings.
6. Ice-making plant to supply ice for cars, restaurants, etc.
7. Refrigeration for restaurant, kitchen, and storage boxes, and flower booth.
8. Water filtering and cooling plant to furnish supply of drinking water.
9. Car heating in train shed, storage, and express yards.
10. Compressed air supply for charging and testing train brakes.
11. Fire protection for the various buildings and train shed roof.
12. Disposal of storm water and drainage from waterproofed structure.
13. Frost protection for roof conductors.
14. Steam and hot water supply for head house.

Instead of letting these diversified items to many separate contractors, it was decided to place the whole in the hands of a single firm of engineer-contractors, both with a view of securing an undivided responsibility, and also because this course appeared to offer many advantages as to unity of design and economy of execution. The satisfactory manner in which the work was accomplished will be understood when it is stated that the plant was started during the adverse conditions accompanying a great snow storm and that all portions operated successfully from the very start.

For the details of the various portions of the work the reader must be referred to the original paper, where will be found a much fuller description of details than is generally made public in such cases. The question for discussion here is that which was elicited at the time of the presentation of the paper, *i. e.*, the advantages and disadvantages of the method adopted.

The practice in such cases is radically different in England and in America. The consulting engineer, as the term is used in England, is but little known in the United States, the branch of the profession bearing that title being occupied mainly with expert advice in legal questions with municipal problems, and with advisory matters generally. In England such an undertaking would probably have been placed in the hands of a consulting engineer, by whom fully detailed plans would have been prepared, to which plans all contractors would have been obliged to conform, the work being subjected to rigid inspection as it progressed.

In the United States, on the contrary, the whole was turned over to a single firm, both for design and execution, with full liberty as to the methods employed and correspondingly full responsibility as to results attained.

The outcome was an entirely satisfactory performance within the limited time available, and at a greatly reduced cost over what could have been obtained under the older method of working.

Assuming an entire responsibility and honesty on the part of the undertakers, the reasons for the attainment of the above results will be apparent. Instead of requiring everything to be constructed from new designs, involving all the expense of patterns, drawings and special costs, standard devices were used where possible, and the experience of specialists in all the various lines thus made available. All the advantages of standardizing were thus obtained, while the single control enabled all these interests to be utilized without conflict.

It is a question whether such a method could be introduced into England with suc-

cess, but already the questions involved in the American method of doing things have been made the subject of animated discussion, and the difference in methods between the two countries has been held in some quarters to be largely responsible for the success with which America has entered into competition with England in all parts of the world. Viewed in this light, this paper will doubtless receive much attention on both sides of the Atlantic, as the fullest detailed account of the American method, carried to extreme limits on a very large scale, which has yet been given to the public.

Fly Wheels and Shafts.

ONE of the features of the discussion about the Glasgow tramway engines was that of the large shafts and heavy fly-wheels in the proposed American designs, and now a communication upon the same points appears in the *American Machinist* from the pen of Mr. W. H. Booth, which elicits comment.

Mr. Booth notes the curious change in opinion concerning engine speeds both in England and America. It was not so very long ago that America was regarded as the home of high-speed engines, while in England the precedent of the old beam engine kept down speeds of rotation. Now all this seems to have changed. English engines are of high rotative speeds, and it is only American engineers who specify slow speeds. Thus the Glasgow engines, over which there has been quite a little fuss, are intended to run at a speed of only 75 revolutions a minute, with a stroke of 5 feet, this being only about half the speed of some marine engines of similar character.

This slow speed has been accompanied with the use of very heavy fly-wheels, and what have been criticised as being excessively large shafts, the diameter in some cases being double what would correspond with current marine practice, notwithstanding the sudden and heavy stresses to which marine-engine shafts are subjected.

Assuming that these large diameters are intended to resist the sudden stresses due to quick changes in load in electric tramway service, Mr. Booth proceeds to show that the maximum stress in an engine is that due to the full boiler-pressure exerted upon the piston at the dead points, and maintains that every well-designed engine is intended to withstand such stresses. He then explains that by placing the generator-armature on the same end of the shaft as the fly-wheel the severe stresses are isolated from the engine and confined to the short straight portion of shaft between the armature and the fly-wheel.

The opinion in England is that the stresses in traction work have been much overrated, and that as the exchange of energy between fly-wheel and armature is not absolutely instantaneous, the stresses upon the shaft are not excessive. Still it is admitted that an allowance requires to be made for the excess of stress produced by even moderately sudden accessions of load.

Mr. Booth suggests that such stresses may be entirely eliminated by making the fly-wheel a part of the generator in a manner similar to that already employed in the construction of alternating-current generators.

As a matter of fact the question of these stresses has had but little to do with the proportions adopted by the leading American builders of engines for traction power-house service. As will be seen by reference to the illustrations of the engines for the power house of the Metropolitan Traction Company of New York, as shown in another portion of this issue, the armature, while carried on the shaft, is driven by direct connection to the body of the fly-wheel, so that the stresses of rotation only reach the shaft after passing through the fly-wheel, and the suddenness of their changes need not affect the shaft at all.

The real reasons for the adopted dimensions of shaft are altogether different from those assumed by Mr. Booth, being, in the first place, to provide such ample projected journal-bearing area as to reduce the unit pressure to a very moderate amount, and, second, in consequence, to reduce the wear upon the journal bearings to such a very small amount as to prevent appreciable settling of the armature with respect to the field. It is of much importance to insure the concentric position of armature and field in the first erection of the machine, since the magnetic balance thus secured

is desired, while the only manner in which this relation can be maintained is by providing what might otherwise appear to be excessive dimension for the journal bearings.

It must not be forgotten that the change of practice in America from small high-speed engines to large, heavy, slow-speed ones, has not been caused by the efforts of any especial class of constructors and engineers, but has been a growth due to the demands of experience in that country in which, up to the present time, electric traction has been developed to an extent far exceeding that of all other portions of the world together. Under such conditions it ought not to be difficult to ascertain the causes for the adoption of existing designs nor the reasons for their continuance.

The Albany Filtration Plant.

In view of the active interest which is being taken both in Europe and America in regard to the question of providing pure water supply to cities, the paper of Mr. Allen Hazen, contributed to the Proceedings of the American Society of Civil Engineers, describing the Albany filter plant, is an important contribution to the practical side of the question.

The city of Albany has of late been supplied with water from the Hudson river, notwithstanding the fact that the drainage from many large towns above polluted the stream and a portion of the sewage of the city itself, under certain conditions, found its way into the intake. Under such circumstances it is not a matter for surprise that the typhoid fever death-rate in the city became excessive, and various attempts were made to secure an unpolluted supply. Inability to succeed in these attempts led to the decision to continue the use of Hudson water, removing the intake to a point somewhat further above the city, and installing slow sand filters to remove the bacteria which cause disease.

In July, 1897, the preparation of plans for the filters was begun, and the complete plant is now in successful operation. The plant consists of a sedimentation basin 383 feet by 600 feet in area, from which the water flows to eight vaulted filter beds, each 121 by 258 feet in area. The object of covering the filters was to protect them from the weather, it being quite cold in Albany during the winter, and the entire construction is of masonry, the piers, cross-walls, and linings of the outside walls being of vitrified brick, and all the other masonry being of concrete. Inverted groined concrete arches are used to form the floors, and the roofs are of concrete vaulting, of 12 feet span. The vaulting is covered with 2 feet of earth, grassed on top, the drainage from this soil being delivered into the filter beds and allowed to pass through with the river water.

The drains beneath the floors were put in before the construction of the latter was begun, and thus no break in the inverted arches was necessary. The construction of these underdrains is an important matter, as it is necessary to provide sufficient capacity to reduce the resistance to a minimum and at the same time cause the pull upon the remote parts of the filter to be as nearly as possible equal to that at the points near the outlet.

The bottoms of the beds are covered with gravel, three sizes being used. The coarsest is in sizes between 1 and 2 inches, this being used to surround the pipe drains and to cover a portion of the floor. The intermediate grade, of sizes between 1 inch and ⅜ inch, is used in a layer of about 2 inches thick, and above this is a layer of finer gravel in sizes between ⅜ and 3-16 inch, to a depth of 2½ inches. Above this comes the actual filtering bed of river sand, 4 feet in depth, the sand being selected so as to be free from organic matter, clay, and lime, the latter being found objectionable in that it acts to harden the water.

The area of each filter bed is 0.7 acre, each filter having a capacity of 2,100,000 gallons daily, and as one filter is always undergoing cleaning, the capacity of the plant with seven filters in operation is 14,700,000 gallons per day. This is a nominal rate which may be exceeded upon demand, the intake, pumping station, and piping being proportioned for a maximum capacity of 25,000,000 gallons per day.

The paper contains many detailed illustrations describing the construction of the plant more fully than is possible in this limited space, and in addition to the construction, illustrations are given of the sand-

washing apparatus, a system of successive water jets being employed for this purpose.

It is interesting to note that this large filter plant has operated most successfully from the start. Mr. Hazen says: "The filters were designed to remove from the water the bacteria which can cause disease. They have already reached a bacterial efficiency of over 99 per cent., and it is expected that their use will result in a great reduction in the death rate from water-borne disease in the city. They also remove a part of the color and all of the suspended matters and turbidity, so that the water is satisfactory in its physical properties. The filters have reached with perfect ease their rated capacity, and on several occasions have been operated to deliver one-third more than this amount; that is to say, at a rate of 4,000,000 gallons per acre daily."

The total cost of this important work was about $500,000, or more precisely $496,633, of which about $325,000 was for the actual construction, the remainder being for land, pumps, piping and engineering expenses. The original estimate was $478,000, so that the actual cost exceeded the estimate by only about 4 per cent.

Naval Engineering in America.

THE Presidential address by Rear-Admiral George W. Melville at the recent convention of the American Society of Mechanical Engineers contained much interesting matter concerning the development of naval engineering in America, and the close relation which Mr. Melville has had with much of this development, by virtue of his position of Engineer-in-Chief for many years, renders anything he has to say of especial interest.

After calling attention to the fact that Fulton not only developed steam navigation in general, but also constructed the first steam war vessel in the world, he reminded his hearers that the first chief of the engineer corps, Mr. Charles H. Haswell, was appointed as long ago as 1836, and is yet living, although his service as chief engineer began before Queen Victoria ascended the throne.

Mr. Melville took occasion in the course of his address to pay a well-merited tribute to the energy and ability of Chief Engineer B. F. Isherwood, and the time and place made his remarks in this connection most appropriate. Mr. Isherwood developed the scientific side of the work of the department of steam engineering in a manner which added greatly to its reputation, but at the same time he received much adverse criticism, and the great value of his work is only gradually being recognized. Experiments upon the properties of steam were made by him on a larger scale than had hitherto been attempted anywhere, and as a result the influence of cylinder condensation, the great problem which confronts the steam engineer to-day, began to receive consideration. His designs for engines, although criticised for their weight and massiveness, were admirably adapted to the hard service required of them during the Civil War, and in the Wampanoag, for both the engines and hull of which Mr. Isherwood was responsible, is found the prototype of the modern swift cruiser, her speed being at least 4 knots higher than any ship of her time; and this was demonstrated in a 37 hour run in rough weather off Cape Hatteras.

In reviewing the progress made in naval engineering in the United States, Mr. Melville named many engineers who received their training at the Naval Academy and did good work in the service, and then retired to take part in private practice or to connect themselves with educational institutions. Two of his predecessors in the office of President of the American Society of Mechanical Engineers, were engineers in the Navy, one being Dr. Thurston and the other Dr. E. D. Leavitt, the former having been a class-mate of Mr. Melville himself, while among other prominent engineers who have contributed to the development of engineering in America and who began in the engineer corps may be named the late Charles E. Emery, George Westinghouse, and Theodore Cooper.

Admiral Melville gave a summary of the present condition of engineering practice in the Bureau of Steam Engineering, much of which corresponds to the matter in his recent annual report, reviewed in these columns last month, and there is every reason to feel, from the manner in which the steam engineering portion of the work of the navy has been done, that practice in the United States is fully abreast with that of any other country.

THE ENGINEERING INDEX

INTRODUCTORY.

The object of this Index is to supply all persons interested in engineering and industrial pursuits with, first, an expert descriptive summary clearly indicating the character and purpose of the leading articles published currently in the established technical journals of the United States, Great Britain, and the Continent—in all languages; and, secondly, an inexpensive means of readily obtaining any portions of this literature that may be desired by our readers.

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *qr*, a quarterly, *s-q* semi-quarterly, etc. Other abbreviations used in the Index are: Ill—Illustrated; W—Words; Anon—Anonymous.

American Architect. *w.* Boston, U. S. A.
American Electrician. *m.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Gas Light Journal. *w.* New York.
American Geologist. *m.* Minneapolis, U. S. A.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Am. Manufacturer and Iron World. *w.* Pittsburg, U. S. A.
American Shipbuilder. *w.* New York.
Annales des Pontes et Chaussées. *m.* Paris.
Architect. *w.* London.
Architectural Record. *q.* New York.
Architectural Review. *s-q.* Boston, U. S. A.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Sydney.
Automobile Magazine. *m.* New York.
Automotor & Horseless Vehicle Jl. *m.* London.
Bridges. *m.* Chicago.
Brick Builder. *m.* Boston, U. S. A.
British Architect. *w.* London.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bulletin Am. Iron and Steel Asso. *w.* Philadelphia, U. S. A.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
California Architect. *m.* San Francisco, U. S. A.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.

Canadian Engineer. *m.* Montreal.
Canadian Mining Review. *m.* Ottawa.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Contemporary Review. *m.* London.
Deutsche Bauzeitung. *b-w.* Berlin.
Domestic Engineering. *m.* Chicago.
Eclairage Electrique. *w.* Paris.
Electrical Engineer. *w.* London.
Electrical Engineering. *m.* Chicago.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electrical World and Engineer. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Electricity. *w.* London.
Electricity. *w.* New York.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricita. *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Cleveland, U. S. A.
Engineers' Gazette. *m.* London.
Engineering. *w.* London.
Engineering and Mining Journal. *w.* New York.
Engineering Magazine. *m.* New York & London.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penn'a. *m.* Pittsburg, U. S. A.
Fire and Water. *w.* New York.
Foundry. *m.* Detroit.
Gas Engineers' Mag. *m.* Birmingham.
Gas World. *w.* London.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. Dei Lav. Pubb. e d. Str. Ferr. *w.* Rome.
Glaser's Ann. f. Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating. *m.* New York.
Horseless Age. *m.* New York.
Ice and Refrigeration. *m.* New York.
India Rubber World. *m.* New York.
Indian and Eastern Engineer. *m.* Calcutta.
Industries and Iron. *w.* London.
Inland Architect. *m.* Chicago.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron & Steel Trades Journal. *w.* London.
Iron Trade Review. *w.* Cleveland.
Journal Assn. Eng. Socities. *m.* Philadelphia, U. S. A.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal of Gas Lighting. *w.* London.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Journal of Sanitary Institute. *qr.* London.
Journal of the Society of Arts. *w.* London.
Journal of U. S. Artillery. *b-m.* Fort Monroe, U. S. A.
Journal Western Soc. of Eng. *b-m.* Chicago, U. S. A.
L'Energie Electrique. *w.* Paris.
Locomotive. *m.* Hartford, U. S. A.
Locomotive Engineering. *m.* New York.
Machinery. *m.* London.
Machinery. *m.* New York.
Marine Engineer. *m.* London.
Marine Engineering. *m.* New York.
Marine Review. *w.* Cleveland, U. S. A.
Master Steam Fitter. *m.* Chicago.
Mechanical World. *w.* London.
Mechanical Engineer. *w.* Manchester.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metal Worker. *w.* New York.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco, U. S. A.
Mining Journal. *w.* London.
Mining Reporter. *w.* Denver, U. S. A.
Mitt. aus d Kgl. Tech. Versuchsanst. Berlin.
Mittheilungen des Vereines für die Förderung des Local und Strassenbahnwesens. *m.* Vienna.
Modern Machinery. *m.* Chicago.
Moniteur des Architects. *m.* Paris.
Moniteur Industriel. *w.* Paris.
Municipal Engineering. *m.* Indianapolis, U. S. A.
National Builder. *m.* Chicago.
Nature. *w.* London.
Nature. *w.* Paris.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Nineteenth Century. *m.* London.
Oest. Monatsschr. f. d. Oeff. Baudienst. *m.* Vienna.
Oest. Zeitschr. f. Berg- & Hüttenwesen. *w.* Vienna.
Ores and Metals. *w.* Denver, U. S. A.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Proceedings Engineers' Club. *qr.* Philadelphia, U. S. A.
Progressive Age. *s-m.* New York.
Railroad Car Journal. *m.* New York.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago.
Railway Magazine. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Railway & Engineering Review. *w.* Chicago.
Review of Reviews. *m.* London & New York.
Revue de Mécanique. *m.* Paris.
Revue Gen. des Chemins de Fer. *m.* Paris.
Revue Technique. *b-m.* Paris.
Revue Universelle des Mines. *m.* Liége.
Rivista Marittima. *m.* Rome.
Sanitary Plumber. *s-m.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Stahl und Eisen. *s-m.* Düsseldorf.
Stevens' Indicator. *qr.* Hoboken, U. S. A.
Stone. *m.* New York.
Street Railway Journal. *m.* New York.
Street Railway Review. *m.* Chicago.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am. Ins. of Mining Eng. New York.
Trans. Am. Soc. of Civil Eng. *m.* New York.
Trans. Am. Soc. of Heat & Ven. Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York.
Transport. *w.* London.
Western Electrician. *w.* Chicago.
Wiener Bauindustrie Zeitung. *w.* Vienna
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *s-m.* Halle a. S.
Zeitschrift für Elektrotechnik. *s-m.* Halle a. S.

ARCHITECTURAL ENGINEERING

CONSTRUCTION.

Bank Building.

The Buffalo Savings Bank. Illustrated description of a banking building containing two domes, one above the other, pendentive ceilings and other special features, including heating arrangements. 4000 w. Eng Rec—Nov. 25, 1899. No. 30954.

Bricklaying.

Practical Bricklaying. Owen B. Maginnis. Part first explains the tools and appliances used, and the attitudes and actions of the bricklayer. 1100 w. Arch & Build—Nov., 1899. Serial. 1st part. No. 30608.

Convention Hall.

The Convention Hall at Kansas City, Missouri. A two-page plate, with description of a building with a seating capacity of 25,000, representing an investment of $240,000. 1800 w. Eng News—Nov. 2, 1899. No. 30686.

Dewey Arch.

The Material for the Permanent Dewey Arch. Extract from an article by Russell Sturgis, in the *N. Y. Evening Post*, discussing this subject. 2500 w. Stone—Oct., 1899. No. 30570 C.

Fireproofing.

A New Form of Hollow Tile Fire-Proof Floor Arch Construction. Illustration, with description of the invention of Henry L. Hinton, called the serrated arch. 1300 w. Eng News—Nov. 9, 1899. No. 30702.

Recent Fire Tests of Fireproofing by the British Fire Prevention Committee. Gives details of a comparative fire test of two different constructions of fireproof doors. 1600 w. Eng News—Nov. 9, 1899. No. 30701.

Foundations.

Foundations for Buildings. Henry W. Hodge. Ideas of what should and should not be done, with descriptive examples. Ill. 3000 w. Br Build—Nov., 1899. No. 31108 C.

Framing.

An Unusual Framed Building. Illustrated description of a building with sides and roof supported by a single truss system like an arch. 700 w. Eng Rec—Nov. 18, 1899. No. 30842.

Handling.

Lifting a 24-Ton Girder Four Stories. Describes a difficult undertaking carried out during one night when the streets were free from traffic. 1000 w. Eng Rec—Nov. 11, 1899. No. 30715.

N. Y. Capitol.

The New York Capitol Building. Cuyler Reynolds. Historical account of this edifice, which has cost nearly thirty million dollars, illustrating many parts, describing and criticising the work. 5000 w. Arch Rec—Oct.-Dec., 1899. No. 30730 C.

Public Baths.

The Sutro Baths, San Francisco. Describes the structural features of a large bathing establishment on a terrace quarried out of the face of a cliff. 900 w. Eng Rec—Nov. 11, 1899. No. 30717.

Public Library.

A Public Library, to Cost One Hundred Thousand Dollars. Thomas M. Kellogg. The first of a series of articles illustrative of a library building, and showing the possibilities of brick architecture. Ill. 1500 w. Br Build—Nov., 1899. Serial. 1st part. No. 31107 C.

The Washington Public Library. Illustrated description of the general arrangement of the Carnegie library. 1800 w. Eng Rec—Nov. 11, 1899. No, 30716.

Roof Trusses.

Pin and Riveted Roof Trusses. Editorial discussion of the relative merits of the two classes. 900 w. Eng Rec—Nov. 11, 1899. No. 30703.

Stairs.

The Construction of Circular Stairs and Spiral Vaults. Lawrence Harvey. Read before the British Arch. Assn. An account of the origin of this form of stairway, with some hints on the construction. 1500 w. Brit Arch—Nov. 3, 1899. No. 30754 A.

Steel-Cage Construction.

Wall Supports in a Steel Cage Building. Illustrated description of the characteristic steel-cage details in a 16-story building for offices and light manufacturing. The Vincent Building, New York. 1000 w. Eng Rec—Nov. 4, 1899. No. 30654.

Stone.

Color and Decay of Stone. First article on "The Building Stones of Wisconsin," reviewing a recently issued volume by Ernest Robinson Buckley. 4000 w. Stone—Oct., 1899. Serial. 1st part. No. 30568 C.

Limestones and Marbles of Alabama. Information concerning stones for build-

ing, paving, curbing, etc. 2500 w. Stone—Oct., 1899. No. 30569 C.

Stone in American Architecture. Russell Sturgis. Interesting illustrated discussion of the use of various stones as a material, stone-working, etc. 10,000 w. Arch Rec—Oct.-Dec., 1899. No. 30731 C.

The Return to Stone. W. S. Adams. On the increase in favor recently shown for this material. Ill. 1200 w. Arch Rec—Oct.-Dec., 1899. No. 30732 C.

Use of Oolitic Stone in England. Extract from article published in the *Stone Mason*, of Bristol, Eng. Concerning the use of this stone and its weathering properties. 600 w. Stone—Nov., 1899. No. 31110 C.

Tiles.

Manufacture of Tiles in Foreign Countries. Consular reports concerning this industry from the various countries. 8300 w. U. S. Cons Repts. No. 581—Nov. 16, 1899. No. 30791 D.

HEATING AND VENTILATION.

Bank Building.

A Hot-Blast Gravity Steam-Heating Apparatus. Illustrated description of a system of heating and ventilation installed in a Utica bank building, an unusual feature of the work being the provision for the ventilation of many of the offices leased to tenants. 1500 w. Eng Rec—Nov. 4, 1899. No. 30655.

Dust Removal.

Sanitation of Establishments Used for Color Printing (Assainissement des Locaux Destinés à l'Impression à l'Aide des Couleurs en Feuilles). J. Carlioz. A discussion of the unhealthfulness of color printing by the "dusting on" processes, with illustrations showing methods of arranging exhaust ventilating fans for the removal of the dust. 1800 w. Génie Civil—Nov. 4, 1899 No. 31006 D

Heating Surface.

Heating Surface: Its Best Form and Relation to Radiating Surface. John Kitchen. Read before the British Inst. of Heat. and Ven. Engs. The necessity of understanding the conditions to be fulfilled, in order to reach correct conclusions. Discusses different systems and experiments. 3500 w. Plumb & Dec—Nov. 1, 1899. No. 30771 A.

Radiation.

Radiating Surface. Earnest T. Child. A comparison of the methods of determining the proper amount of radiating surface. 2200 w. Met Work—Nov. 11, 1899. No. 30682.

Ventilation.

Ventilation in Its Relation to Heating, etc. W. R. Maguire. Read before the British Inst. of Heat and Ven. Engs. Discusses some of the systems in use, and points worthy of attention. 5000 w. Plumb & Dec—Nov. 1, 1899. No. 30770 A.

PLUMBING AND GAS FITTING.

Drainage.

House Drainage as It May Be. The first of a series of articles on house drainage. Ill. 1300 w. Dom Engng—Nov., 1899. Serial. 1st part. No. 30846 C.

Fittings.

Sound Gas Fittings. Norton H. Humphreys. The importance of seeing that all fittings are gas tight. 2000 w. Jour Gas Lgt—Nov. 7, 1899. No. 30794 A.

Suburban.

Suburban Gas Lighting. Describes work in a suburban dwelling, of unusual excellence. 2000 w. Dom Engng—Nov., 1899. No. 30847 C.

MISCELLANY.

Address.

Presidential Address Before the Royal Institute of British Architects. William Emerson. A review of the architecture and architects of the past century. 9000 w. Builder—Nov. 11, 1899. No. 30853 A.

Architectural Practice.

English and American Architectural Practice. R. Clipston Sturgis. A comparison of the present conditions of practice in these two countries. 4500 w. Arch Rev—Nov., 1899. No. 30960 D.

Brasses.

Monumental Brasses. G. H. Smith. Read before the British Architectural Assn. Interesting information concerning the development of brasses. Ill. 2000 w. Builder—Nov. 11, 1899. No. 30854 A.

Estimates.

Quantity Bids on Architectural and Engineering Contracts. G. A. Wright. A description of the methods in vogue in many countries and made obligatory by law in some, by which contracting for works is made less of a gamble than under lump sum bids. 3300 w. Eng Rec—Nov. 4, 1899. No. 30656.

Stained Glass.

Domestic Stained Glass in France. René de Cuers. Concerning the present state of the stained-glass window manufacture in general and of domestic stained-glass windows in particular, describing effects and results. Ill. 5500 w. Arch Rec—Oct.-Dec., 1899. No. 30729 C.

CIVIL ENGINEERING

BRIDGES.

Albany.

New York Central Improvements at Albany. An illustrated account of the reconstruction of the Hudson River passenger bridge. 1000 w. R R Gaz—Nov. 10, 1899. No. 30736.

Algiers.

The Construction of the Bridge of Oued Endja, Algeria (La Construction du Pont de L'Oued Endja). A. Daujon. The official report, with full description of the sinking of the pier caisson, and the construction and launching of the girders. An important work in the French-African colony. 15000 w. 1 plate. Ann des Ponts et Chausées—2 Trimestre, 1899. No. 31079 E + F.

Arch.

The Statical Investigation of Arches (Beitrag zur Statischen Untersuchung von Gewölben). M. Marcus. A graphical analysis of the statical reactions in voussoir arches, using the polar diagram and force polygon. 1200 w. Schweizerische Bauzeitung—Oct. 21, 1899. No. 31045 B.

Atbara.

The Atbara Bridge. Illustrated description of the bridge and its erection, the story of the foreman who had charge of its transportation and erection, and Lord Kitchener's speech at its dedication. 4500 w. Eng Rec—Nov. 4, 1899. No. 30650.

Bracing.

The Location of Diagonal Members in Parallel Lattice Girders (Ueber das Centrieren der Diagonalen in Parallel-Gitterträgern). L. Nicolay. A mathematical examination of the conditions obtaining in lattice girders which show the most economical positions for diagonal members. 1000 w. Schweizerische Bauzeitung—Oct. 28, 1899. No. 31047 B.

Ceylon.

Bridge Erection in Ceylon. Describes methods of renewing a bridge without employing falsework. 600 w. Eng Rec—Nov. 11, 1899. No. 30718.

Counter Stresses.

Insufficient Provision for Counter-Stresses in Railroad Bridges. Discussion of paper by Henry S. Pritchard. 1700 w. Pro Am Soc of Civ Engs—Nov., 1899. No. 30936 E.

Deflections.

An Instrument for Measuring and Recording Bridge Deflections. Illustrates and describes an apparatus devised by B. F. Pickering. 700 w. Ry & Engng Rev—Nov. 11, 1899. No. 30748.

France.

Proposed Bridge Across the Rance, France. Information concerning this bridge, stating the conditions to be satisfied. 1000 w. U. S. Cons Repts, No. 568—Nov. 1, 1899. No. 30564 D.

Highway.

The Snake River Bridge. Illustrated description of a cantilever highway bridge having rocker bents under the cantilevers and inclined anchor arms. 2500 w. Eng Rec—Nov. 18, 1899. No. 30835.

Piers.

Concrete Piers, Sangamon River Bridge. Illustrates and describes the method of building some massive concrete piers, the method of doing the work being prescribed by the engineer and not left to the contractor. 600 w. Eng Rec—Nov. 4, 1899. No. 30651.

Plate-Girder.

New Form of Plate-Girder Swing Bridge, C. M., & St. P. Ry. Illustrated description of a bridge of somewhat novel design, made to take the place of a wooden span 161 ft. long, swinging upon a center pier. The conditions were unusual, owing to a proposed improvement of the river channel. 1000 w. Ry & Engng Rev—Oct. 28, 1899. No. 30536.

Rouen.

The New Bridge at Rouen. From *La Nature*. Illustrated description of a transshipping bridge. 900 w. Sci Am Sup—Dec. 2, 1899. No. 31117.

Steel Bridge.

The Delaware River Bridge at Bridesburg. Illustrated description of the details of a structure with both plate-girder and large truss spans. 2800 w. Eng Rec—Nov. 25, 1899. No. 30947.

Stresses.

Statically Indeterminate Structures. An editorial on the need of members which make a structure statically indeterminate. 1100 w. Eng Rec—Nov. 4, 1899. No. 30648.

Suspension.

The Cables and Suspenders for the New East River Bridge, New York City. Illustrates and describes the general details for the center suspension span. 2700 w. Eng News—Nov. 23, 1899. No. 30911.

The Latest Suspension Cable Specifications. The requirements for the steel

wire and workmanship for the four cables of the new East River bridge, New York. 2000 w. Eng Rec—Nov. 18, 1899. No. 30836.

The New East River Bridge. Gives specifications for steel cables, suspenders, coverings, sheaves, bands, and their appurtenances. Ill. 2500 w. Ir Age—Nov. 16, 1899. No. 30782.

The New East River Bridge. Illustrated description of some details of the parts to be contracted for. 700 w. R R Gaz—Nov. 24, 1899. No. 30942.

The Stiffened Suspension Bridge. An editorial discussion of the field of usefulness of this type and of the methods of designing the stiffening truss. 1100 w. Eng Rec—Nov. 18, 1899. No. 30834.

Viaduct.

Redecking a Viaduct. Illustrated description of the method of renewing a highway bridge floor. 400 w. Eng Rec—Nov. 11, 1899. No. 30711.

Widening.

Widening a Washington Highway Bridge. Describes the addition of cantilever brackets for side walks, to a plate-girder skew bridge. 700 w. Eng Rec—Nov. 11, 1899. No. 30712.

CONSTRUCTION.

Breakwaters.

The Reaction Breakwater as Applied to the Improvement of Ocean Bars. Discussion of the paper by Lewis M. Haupt. 20000 w. Pro Am Soc of Civ Engs—Nov., 1899. No. 30937 E.

The 3000-Ton Concrete Blocks and Rolling Caissons at the Bruges Ship Canal, Belgium. Abstract from paper of L. V. Vernon-Harcourt, read before the Inst. of Civ. Engs. Describes the method of making these monoliths of concrete, which weigh from 2500 to 3000 tons. 1200 w. Eng News—Nov. 9, 1899. No. 30696.

Dam.

Proposed Design for a Steel and Concrete Dam. John S. Fielding. Illustrates and describes a truss design, discussing its advantages. 2200 w. Eng News—Nov. 16, 1899. No. 30798.

Rock Dams with Metallic Reinforcement (Barrages-Réservoirs en Remblai Rocheux). A. Dumas. With illustrations of important reservoir-dams in California, constructed with sheet-iron core, and stone embankment. 3000 w. Génie Civil—Oct. 21, 1899. No. 31001 D.

Estimates.

See Architectural Engineering, Miscellany.

Foundations.

See Architectural Engineering, Construction.

Highway.

State Aid Roads in New Jersey. C. E. McDowell. Information concerning the roads started or completed. 3000 w. Stone—Oct., 1899. No. 30567 C.

The Karlstädt Imperial Road Between Jugorje and Möttling (Die Umlegung der Karlstädter Reichsstrasse zwischen Jugorje und Möttling). Karl Grünhut. With topographical map, and profiles, together with tables showing the influence of grades on the cost of transport. 4000 w. 1 plate. Oesterr Monatschr f d Oeffent Baudienst—Nov., 1899. No. 31038 D.

The Maintenance of Highways. A review of recent advice by the State Engineer of New York. 1800 w. Eng Rec—Nov. 18, 1899. No. 30838.

Pier.

Landing Pier at Pauillac (Appontement de Pauillac, Gironde). Ch. Talausier. Illustrated description of the new pier on the Gironde, forming a deep-sea port for the city of Bordeaux. Serial, Part I. 2500 w. 1 plate. Génie Civil—Nov. 4, 1899. No. 31004 D.

Piers.

See Bridges.

Pile-Drivers.

Two Railway Pile-Drivers. Illustrates and describes the machine designed by G. W. Smith, giving extracts from his paper in the *Jour. of W. Soc. of Engs.* Also another pile-driver built for the G., C., & S. F. Ry. 2400 w. Eng News—Nov. 16, 1899. No. 30796.

Roof Trusses.

See Architectural Engineering, Construction.

Tunnel.

The North Bessemer Tunnel. Describes the driving of a tunnel 2900 ft. long for a double-track railway. 600 w. Eng Rec—Nov. 11, 1899. No. 30719.

HYDRAULIC AND MARINE.

Bar.

The Bar at Rio Grande do Sul (La Barra de Rio Grande do Sul). L. L. Vauthier. An account of the works for the maintenance of a permanent channel at the mouth of the canal connecting the port of San Pedro, Brazil, with the ocean. 8000 w. Ann des Ponts et Chaussées—2 Trimestre, 1899. No. 31082 E + F.

Canals.

The Canal Problem in New York: A New Solution. A reprint of editorial in the *Journal of Commerce.* Suggests the building upon the banks of the Erie Canal a double-track railway for freight

traffic only. 3500 w. Eng News—Nov. 9, 1899. No. 30698.

The Canal System of Canada. Describes the improvements recently made, which will make it possible for vessels drawing 14 ft. to steam from Lake Superior to the sea. 2000 w. Engr, Lond—Nov. 3, 1899. No. 30757 A.

The Dortmund-Ems Canal. A brief account of this important waterway. Ill. 1200 w. Engr, Lond—Nov. 17, 1899. No. 30996 A.

The Transformation of the Lateral Canal of the Loire (Transformation du Canal Latéral à la Loire). M. Mazoyer. A full account of the improvement works, with illustrations of the aqueducts, bridges, and masonry details. 18000 w. 3 plates. Ann des Ponts et Chausées—2 Trimestre, 1899. No. 31081 E + F.

Cisterns.

Cisterns: Their Use and Necessity with Constant Water Supply. Ernest Collins. Read at the Congress of the Sanitary Inst. Discusses the need of reservoir cisterns, their care, and the best systems. 2200 w. Plumb & Dec—Nov. 1, 1899. No. 30769 A.

Drainage.

The Drainage of the Pinsk District, Russia (Trockenlegung der Sümpfe in Polesie). With a very complete map, showing the existing canalisation of the district, and the projected improvements for the drainage of this marshy district of western Russia. 2000 w. 1 plate. Oesterr Monatschr f d Oeffent Baudienst—Nov., 1899. No. 31039 D.

The Drainage Works of New Orleans. Illustrated description of the open and closed canals for surface drainage. 2000 w. Eng Rec—Nov. 11, 1899. No. 30708.

The Electric Drainage of New Orleans. Lyman C. Reed. A statement of the conditions and an illustrated detailed description of the plant. 4400 w. Elec Wld & Engr—Nov. 18, 1899. No. 30809.

The Main Drainage of London. Extracts from the report of the Main Drainage Committee of the London County Council, with comments. 4500 w. Engr, Lond—Nov. 10, 1899. No. 30864 A.

The Main Drainage of Ottawa. Illustrated description of the details of a system of difficult river crossings. 1800 w. Eng Rec—Nov. 25, 1899. No. 30951.

Driven Wells.

Driven Wells and Their Proper Treatment. Jas. R. Maxwell. Read at the convention of the Central States Water Works Assn., Cincinnati, Ohio. Gives suggestions derived from long experience. 1000 w. Fire & Water—Nov. 11, 1899. No. 30741.

Dry Dock.

Hydraulic Lifting Dry Dock at Union Iron Works, San Francisco. Illustrated detailed description. 1500 w. Marine Engng—Nov., 1899. No. 30610 C.

Filtration.

An Automatic Controller or Regulating-Weir. Illustrated description of an apparatus enabling a mechanical filter to be regulated with unusual closeness. 800 w. Eng Rec—Nov. 25, 1899. No. 30948.

Bacterial Test of a Mechanical Filter at Louisiana, Mo. Gives results of a filter which is treating water drawn from the Mississippi River. Ill. 1800 w. Eng News—Nov. 16, 1899. No. 30799.

Recent Experience with the Lawrence Filter. A description of the clogging of part of an open sand filter and the method of repairing the trouble, which was in the under drains. 2000 w. Eng Rec—Nov. 25, 1899. No. 30949.

The Albany Water Filtration Plant. Allen Hazen. Gives an historical account of the supply, a description of the plant, and information relating to its operation and construction. Ill. 13600 w. Pro Am Soc of Civ Engs—Nov., 1899. No. 30935 E.

Leakage.

The Leakage from Street Mains. Summary of investigations made by J. J. R. Croes, in New York, showing that the leakage from old pipes is much greater than is usually supposed. 1000 w. Eng Rec—Nov. 4, 1899. No. 30657.

Locks.

Locks and Lock Gates for Ship Canals. Henry Goldmark. A detailed discussion of their construction and operation, with historical review. 7000 w. Jour Assn of Engng Socs—Sept., 1899. No. 30566 C.

Nile.

The Engineering Control of the Nile. Considers the means which have been and are to be adopted for the control of this river. 3500 w. Builder—Oct. 21, 1899. Serial. 1st part. No. 30535 A.

Utilization of the Nile. An illustrated description of the finally sanctioned design of the dam at Assouan and the barrage at Assiout. 1800 w. Engr, Lond—Nov. 3, 1899. No. 30758 A.

Oder.

The Harbor of Cosel on the Oder, and its Present Commerce (Der Oder-Hafen zu Cosel und sein Bisheriger Verkehr). J. Riedel. An account of the important internal commerce centering at Cosel on the canalised Oder, near Breslau. 2000 w. Zeitschr d Oesterr Ing u Arch Ver—Nov. 10, 1899. No. 31021 B.

Pipe Incrustation.

The Incrustation of Iron Pipes at the Torquay Water Works. William Ing-

ham. Read before the Inst. of Mech. Engs. Illustrates and describes the pipe scrapers used, also the condition of the pipes, and the results. 4000 w. Engng—Nov. 3, 1899. No. 30752 A.

Reservoirs.

Covered Reservoirs. Frank L. Fuller. Illustrates and describes reservoirs from the writer's designs. 3800 w. Jour Assn of Engng Socs—Sept., 1899. No. 30565 C.

Rhine.

The Regulation and Information Service on the Rhine in the Vorarlberg (Der Wasserwehr und Nachrichtendienst am Rhein in Vovarlberg). An account of the methods used for regulating the upper Rhine; also the telephone service for communicating warnings of sudden freshets. 3000 w. Oesterr Monatschr f d Oeffent Baudienst—Nov., 1899. No. 31040 D.

Scour.

Dangerous Scour Caused by Bridge Piers. A note on the effect of piers in the Gatineau River, Canada, and the remedy. 600 w. Eng Rec—Nov. 11, 1899. No. 30710.

Storage Reservoirs.

Surveys of Sites for Irrigation Storage Reservoirs by the U. S. Geological Survey. A statement relating to water storage, proposed by F. H. Newell, of the Div. of Hydrography of the U. S. Geol. Surv. 1500 w. Eng News—Nov. 23, 1899. No. 30912.

Streams.

Stream Measuring in the United States. F. H. Newell. Introduction of a report for 1897, reprinted from the U. S. Geological Survey annual report. Ill. 2200 w. Sci Am Sup—Nov. 11, 1899. Serial. 1st part. No. 30680.

Water Rights.

Public and Private Rights in River Water. The decision of an Illinois court concerning the right of Elgin to take water from a mill-pond. 2800 w. Eng Rec—Nov. 18, 1899. No. 30839.

Water Supply.

New York's Water Supply. Peter Milne. Gives the writer's opinions concerning some points mentioned in paper of J. J. R. Croes, and calls attention to other facts. 1800 w. Fire & Water—Nov. 18, 1899. No. 30845.

Summary of the Report of the Commission on the Extension and Improvement of the Water Supply of the City of Philadelphia. 5000 w. Jour Fr Inst—Nov., 1899. No. 30606 D.

The Increase of Water Consumption. Editorial comment on this subject. 1400 w. Fire & Water—Nov. 4, 1899. No. 30667.

The London Water Question. Editorial discussion of matters relating to the proposed supply. 3300 w. Builder—Nov. 11, 1899. No. 30852 A.

The Water Supply of Manhattan and the Bronx Boroughs. Extracts from the report of J. J. R. Croes, and from a letter of Dr. P. Sherwood Dunn. 2500 w. Fire & Water—Nov. 11, 1899. No. 30740.

The Water Supply Question in Bavaria (Der Stand der Wasserversorgung in Bayern). With especial reference to the water-bearing strata beneath Munich and the surrounding country. 2500 w. Zeitschr d Ver Deutscher Ing—Nov. 4, 1899. No. 31035 D.

Water-Works.

A Lesson in Water-Works Management. Illustrated article showing the economy with which the New York water works were managed whenever the commissioner was able to understand engineering reports and the waste which occurred at all other times. 800 w. Eng Rec—Nov. 11, 1899. No. 30705.

Turkish Syphons at Constantinople. Edward Wegmann. Illustrated description of the souterazi which the Turks consider necessary for the successful operation of a long water main. 700 w. Eng Rec—Nov. 11, 1899. No. 30707.

Water-Works Expansion in Boston. J. A. Stewart. Illustrates and describes interesting work in carrying out the plans of the Metropolitan Water Board. 2400 w. Sci Am—Nov. 4, 1899. No. 30582.

Water-Works in Panama. Printed translation of the invitation for bids to build the aqueduct to supply the city with water. 3800 w. U. S. Cons Repts, No. 580—Nov. 15, 1899. No. 30780 D.

MATERIALS.

Asphalts.

The Physical Properties of Asphalts and Asphaltic Cements. W. H. Broadhurst. Read before the Am. Soc. of Munic. Imp. Gives a detailed examination of the properties, and account of tests. 1500 w. Munic Engng—Nov., 1899. No. 30578 C.

Bricklaying.

See Architectural Engineering, Construction.

Brick Tests.

Strength of Brick Work. A summary of tests of brick piers. Ill. 900 w. Brick—Nov. 1, 1899. No. 30691.

Cement.

Cement Rock in Florida. From the report of Uriah Cummings concerning this remarkable deposit of natural hydraulic cement. 900 w. Brick—Nov. 1, 1899. No. 30690.

Economics of Cement Mortar. Ira O. Baker. Abstract. Presents methods of equating results, and discusses tests and related subjects. 1400 w. Pro of Ill Soc of Engs & Surv—1899. No. 30547 E.

Some Experiences with Portland Cement. W. K. Eldridge. Read before the Am. Soc. of Munic. Imp. An account of experiments and results. 3000 w. Munic Engng—Nov., 1899. No. 30579 C.

Concrete.

Tests of Cement and Concrete (Cement und Beton proben). Josef Schustler. A tabulated account of tests made during 1896-97 in the laboratory of Robert Wünsch at Budapest, with carefully arranged data concerning the various specimens tested. Two articles. 5000 w. Zeitschr d Osterr Ing u Arch Ver—Oct. 20, 27, 1899. No. 31019 each B.

Drying.

The Determination of Atmospheric Humidity in Drying Plants (Beitrage zur Bestimmung der Atmosphärischen Feuchtigkeit in Trockenanlagen). Paul Fuchs. A study of hygrometry from the technological standpoint, giving practical methods of determining the moisture in connection with drying apparatus. 3000 w. Gesundheits-Ingenieur—Oct. 31, 1899. No. 31041 B.

Fatigue.

Note Upon Actual and Computed Fatigue (Note sur les Fatigues Réelles et les Fatigues Calculées). M. Mesnager. An account of a series of tests made upon two girder bridges on the Orleans railway. The observed deformations agreed fairly with the computations. 8000 w. 3 plates. Ann des Ponts et Chaussées—2 Trimestre. 1899. No. 31083 E + F.

Stone.

See Architectural Engineering. Construction.

Structural Steel.

See Mining and Metallurgy, Iron and Steel.

MUNICIPAL.

Consolidation.

The Financial Effects of Consolidation. Bird S. Coler. A lecture at Cooper Union by the Comptroller of New York, on the results of the greater New York consolidation. 4000 w. Eng Rec—Nov. 25, 1899. No. 30955.

The Penalties of Bigness. An editorial review of certain troublesome problems which have resulted from the growth of London particularly; refers to water and sewerage projects. 1200 w. Eng Rec—Nov. 25, 1899. No. 30946.

Disinfecting.

The Disinfecting Station at Zurich. James H. Fuertes. Illustrated description of the municipal station and its fittings. 1000 w. Eng Rec—Nov. 11, 1899. No. 30713.

Drainage.

See Construction.

Municipal Works.

The Municipal Gas and Water Works at Halle on Saale (Die Stadtische Gas und Wasserwerke zu Halle a. S.). A full report of the construction and operation of the plant, with plan showing the arrangement of the gas works and of the sand filters. 3500 w. 1 plate. Gesundheits-Ingenieur—Oct. 31, 1899. No. 31042 B.

Pavements.

Brick Paving in Several Cities. L. M. Hastings. Read before the Am. Soc. of Munic. Imp. Information concerning the manufacture, wearing qualities, etc. 2300 w. Munic Engng—Nov., 1899. No. 30577 C.

The Life of Pavements. George W. Tillson. Read before the Am. Soc. of Munic. Imp. A study of the conditions affecting the life of city pavements. 5000 w. Munic Engng—Nov., 1899. No. 30576 C.

Paving.

A Portable Asphalt Paving Plant of Large Capacity. Illustrated description of a plant carried on two railway flat cars, containing all the machinery of an asphalt plant. 700 w. Eng News—Nov. 23, 1899. No. 30910.

San Francisco.

A Plan to Beautify Market Street. B. J. S. Cahill. An illustrated account of a plan to greatly beautify the city, with opinions of the scheme. 10300 w. Cal Arch—Oct., 1899. Serial. 1st part. No. 30792 D.

Sewage Disposal.

Sewage Disposal at Aldershot. A statement of the results obtained with the double bacteria-bed system. 1000 w. Eng Rec—Nov. 25, 1899. No. 30953.

Sewage Disposal Experiments at Leeds. A review of experiments with various bacterial processes, chemical treatment and land filtration. 1000 w. Eng Rec—Nov. 4, 1899. No. 30652.

The Moon Island Sewage Reservoir, Boston. Illustrated description of the new basins built to hold sewage until the tide was at the proper stage for its discharge into the sea. 1300 w. Eng Rec—Nov. 4, 1899. No. 30653.

The Provision for Storm Water in Sewage Purification Work. A. J. Martin. Condensed from a paper read before the Sanitary Inst., at Southampton. A

discussion of the difficulties and statement of conclusions. 2800 w. Eng News —Nov. 16, 1899. No. 30803.

The Sewerage of Walsall, England. Illustrated description of works including some sewers running under a head, and a disposal system with chemical treatment supplemented by land filtration. The results of the treatment are stated, and an unusual dredge for cleaning sewers is illustrated. 2500 w. Eng Rec —Nov. 18, 1899. No. 30837.

The Use of Coke in the Treatment of Sewage. Review of the report of Frank Clowes on the bacterial treatment of sewage, givng an account of experiments carried out on the crude sewage of London in the coke-beds at Crossness. 5000 w. Jour Gas Lgt—Oct. 24, 1899. No. 30633 A.

Sidewalks.

Specifications for Concrete Sidewalks and Driveways. Specifications employed in laying walks around the grounds of the Univ. of Kansas. Abstract. 1000 w. Eng News—Nov. 9, 1899. No. 30700.

Street Traffic.

Address of Sir John Wolfe Barry. Discusses street improvements and their estimated cost, and the results attained. Maps. 6000 w. Jour Soc of Arts—Nov. 17, 1899. No. 30965 A.

London Street Traffic. Editorial discussion of paper by Sir John Wolfe Barry. 2000 w. Engng—Nov. 17, 1899. No. 30985 A.

Water Rates.

Water Rates in the Larger Cities of the United States. August Herrman. Read before the Am. Soc. of Munic. Imp. The report considers the rates of 31 cities. 3500 w. Munic Engng—Nov., 1899. No. 30574 C.

Water Works.

See Civil Engineering, Hydraulics.

MISCELLANY.

China.

Public Works at Talienwan. A clipping from the *North China News* in regard to the extensive public works undertaken at this new Russian port. 1000 w. U. S. Cons Repts, No. 584—Nov. 20, 1899. No. 30848 D.

France.

Recent French Engineering. W. H. Booth. Notes on things observed during a recent visit which show ability of French engineers. 1200 w. Am Mach—Nov. 23, 1899. No. 30925.

Military Engineering.

The Volunteer Engineers in the War with Spain. J. L. Van Ornum. A statement of the value, as shown by recent experience, of permanent volunteer engineering regiments in the State militia. 1300 w. Eng Rec—Nov. 25, 1899. No. 30952.

ELECTRICAL ENGINEERING

COMMUNICATION.

Cable.

The All-British Cable. Full text of the report by the Postmaster-General of South Australia. 4500 w. Elect'n, Lond —Oct. 20, 1899. No. 30528 A.

Galvanometer.

The Sullivan Signalling Galvanometer. Illustrates and describes the instrument and its working, which enables a commander in war time to establish communication through any submarine cable. 1400 w. Elec Rev, Lond—Nov. 3, 1899. No. 30774 A.

Marconi Patents.

Marconi Wireless Telegraph Patents. From the London *Electrician*. Gives the substance of the first three patents, with illustrations. 2200 w. Elec Wld & Engr —Nov. 11, 1899. No. 30727.

Repeater.

A Repeater for Use in Wireless Telegraphy. Illustrates and describes an instrument designed by Emile Guaricci-Foresio. 900 w. Elec Rev, Lond—Nov. 10, 1899. No. 30860 A.

Space Telegraphy.

Experiments in Wireless Telegraphy between Chamonix and the Summit of Mont Blanc (Expériences de Télégraphie sans Fil, Executées entre Chamonix et le Sommet du Mont Blanc). MM. J. and L. Lecarme. A communication to the French Academy, giving the details of these successful communications between stations of widely differing altitude. 1000 w. Comptes Rendus—Oct. 16, 1899. No. 31010 D.

Wireless Telegraphy. William Baxter, Jr. An explanation of the principles of the system used by Marconi in reporting the recent races for the America's cup. Ill. 2500 w. Mach, N. Y.—Nov., 1899. No. 30562.

Telegraph.

Abuse of the Telegraph. W. W. Ryder. Extracts from a paper read before the St. Louis Ry. Club. Calls attention to the overcrowding and unnecessary use of the telegraph. Also discussion. 3500 w. Ry & Engng Rev—Nov. 4, 1899. No. 30669.

DISTRIBUTION.

Alternating Currents.

The Drop in Alternating-Current Wires. Cecil P. Poole. Discussion of methods of computing. 800 w. Elec Wld & Engr—Nov. 18, 1899. No. 30811.

Conduits.

Underground Conduits for Electrical Conductors. C. H. Sewall. Gives briefly a review of the history of underground construction, and describes various types of conduit and the requirements of construction, with measures for meeting them. 2500 w. Elec Engng & Tel Mag—Nov., 1899. No. 30934.

Currents.

The Distribution of Currents in Alternating Circuits (Ueber Stromvertheilung in Wechselstromnetzen). C. P. Feldmann & Josef Herzog. Methods for various numbers of conductors are shown, and a variety of numerical examples given. 4500 w. Elektrotech Zeitschr—Nov. 9, 1899. No. 31073 B.

Electric Wire.

Electric Wire in Buildings. Alton D. Adams. A discussion of various systems and methods. 1600 w. Arch & Build—Nov., 1899. Serial. 1st part. No. 30607.

Protection.

The Protection of Secondary Circuits from Fire Risks. Cary T. Hutchinson. A statement of the dangers, and the means of protection that have been employed, recommending the grounding of secondaries. Also discussion. 9500 w. Trans Am Inst of Elec Engs—Aug.-Sept., 1899. No. 30541 D.

Transformer.

A New Type of Transformer (Ueber eine Neue Type von Transformatoren). C. P. Feldmann. An illustrated description of the new Helios transformer, in which the method of winding is simplified. 1500 w. Elektrotech Zeitschr—Nov. 2, 1899. No. 31072 B.

Wiring.

An Electric Wiring "Reverie." Fred. Bathurst. A discussion of systems in use. 2200 w. Elec, Lond—Oct. 27, 1899. No. 30629 A.

ELECTRO-CHEMISTRY.

Electro-Chemical Plants.

Prof. Lunge, of Zurich, on the Future of Water-Power and Electrolytic Alkali Processes. John B. C. Kershaw. A review of lecture delivered in Liverpool on the changes now being brought about by the utilization of water-power for industrial purposes, especially for chemical manufactures. 1600 w. Elec Rev, Lond—Oct. 20, 1899. No. 30533 A.

Electrolysis.

Electrolytic Processes in Industrial Operations. Dr. W. Borchers. An account of the wonderful progress of electrochemical manufacturing, with descriptions and diagrams of the more important forms of apparatus and tables of output, value, and power employed. Points out especially the way in which otherwise wasted water-power has been employed in this industry. 4000 w. Engineering Magazine—Dec., 1899. No. 31094 B.

lectrolytic Generator.

The Apparatus for the Commercial Generation of Oxygen and Hydrogen by the Electric Current. W. S. Franklin. An illustrated detailed description. 800 w. Am Elect'n—Nov., 1899. No. 30603.

Electro-Metallurgy.

The Electrolytic Treatment of Complex Sulphide Ores. Sherard Cowper-Coles. Briefly describes a number of electrolytic processes, confining the paper to wet extraction processes. 2500 w. Elect'n, Lond—Nov. 10, 1899. Serial. 1st part. No. 30861 A.

Explosion.

The Recent Explosion at St. Helens. Gives the gist of the report made by Colonel A. Ford on the circumstances attending the explosion which occurred on May 12, at the Kurtz Chemical Works. Map. 3000 w. Engr, Lond—Nov. 17, 1899. No. 31101 A.

Ozone.

Ozone and Its Technical Applications (Ozon und seine Technische Verwendung). A review of the discovery and history of ozone, and an account of its modern applications in bleaching, sterilisation, and other oxidising uses. Two articles, 4500 w. Die Elektrizität—Oct. 28, Nov. 11, 1899. No. 31085 each B.

The Ozonization of Water (L'Eau Ozonisée). E. Andréoli. A discussion of the oxidizing action of ozone upon organic matter contained in water, calling attention to the many extravagant claims which have been made for the process as distinguished from its real merits. 1200 w. L'Electricien—Nov. 4, 1899. No. 31088 B.

The Sterilization of Water by Ozone. Abstract translation of an article by Th. Weyl, in *Centralblatt für Bakteriologie*, with criticism by Robert Spurr Weston. 900 w. Eng News—Nov. 23, 1899. No. 30918.

ELECTRO-PHYSICS.

Alternating Currents.

The Determination of the Wave Form of Alternating Currents Without a Contact Maker. Harris J. Ryan. Illustrated

description of a method which may be used when the special contact maker apparatus is not available. Discussion. 4000 w. Trans Am Inst of Elec Engs—Sept., 1899. No. 30539 D.

Alternators.

Comments Upon M. Blondel's Theory of Inductor Reaction (Observation sur une Note de M. Blondel Relative à la Réaction d'Induit des Alternateurs). A. Potier. A communication to the French Academy discussing mathematically the theory of M. Blondel. 1500 w. Comptes Rendus—Oct. 23, 1899. No. 31012 D.

Inductor Reactions of Alternators (Sur les Réactions d'Induit des Alternators). A. Blondel. A communication to the French Academy showing how the reaction may be referred to two or three coefficients of self-induction. 1500 w. Comptes Rendus—Oct. 16, 1899. No. 31009 D.

Hertz Waves.

The Transmission of Hertz Waves Through Liquids (Transmission des Ondes Hertziennes à Travers les Liquides). E. Branly. A communication to the French Academy showing the various absorbing powers of different liquids and describing the apparatus and method of investigation. 1500 w. Comptes Rendus—Oct. 30, 1899. No. 31014 D.

Impedance.

The Current Produced in an Inductive Coil by a Parabolic Wave of E. M. F. Alexander Russell. Mathematical solution. 800 w. Elec Rev, Lond—Nov. 10, 1899. No. 30858 A.

Inductance.

The Inductance of a Portion of an Electric Circuit. H. N. Allen. Shows some of the difficulties that may arise, and the means of avoiding them. 1700 w. Elect'n, Lond—Nov. 17, 1899. Serial. 1st part. No. 30977 A.

Induction.

The Influence of Self-Induction Upon the Rate of the Wehnelt Interrupter (Ueber den Einfluss der Selbstinduktion auf die Unterbrechungszahl beim Wehneltschen Unterbrecher). Ernst Ruhmer. A discussion of the theory of Dr. Simon, and a comparison of the computed results with the writer's experiments. 2000 w. Elektrotech Zeitschr—Nov. 9, 1899. No. 31075 B.

Interrupter.

A New Universal Mercurial Jet Interrupter (Ein Neuer Universal-Quecksilberstrahlunterbrecher). Dr. Max Levy. A toothed crown wheel is rapidly rotated by an electric motor, and a jet of mercury forced against the teeth. 2000 w. Elektrotech Zeitschr—Oct. 12, 1899. No. 31063 B.

The Mechanism of the Wehnelt Interrupter. On the investigations by Voller and Walter explaining the various processes to which the action is due. 2400 w. Elec Rev, Lond—Oct. 20, 1899. No. 30532 A.

The Wehnelt Electrolytic Interrupter (Sur l'Interrupteur Electrolytique de Wehnelt). E. Rothé. A communication to the French Academy describing the behavior of the interrupter when, for a constant electromotive force, the external resistance is varied. 1200 w. Comptes Rendus—Oct. 30, 1899. No. 31015 D.

Laboratory.

The High-Pressure Plant in the Electrochemical Laboratory of the Zürich Polytechnic (Die Starkstromanlage in Elektrochemischen Laboratorium des Eidg. Polytechnikums in Zurich). F. Largiader. With plan and photographs of the building showing arrangement of the switches, converter, instruments, etc. 1800 w. Schweizerische Bauzeitung—Nov. 11, 1899. No. 31048 B.

Lines of Force.

The Distribution of Lines of Force in Grooved Armatures (Ueber die Kraftlinienvertheilung in Nuthenankern). Dr. F. Niethammer. An elaborate mathematical treatment, with diagrams, to assist in the determination of the ampere windings. 6000 w. Elektrotech Zeitschr—Nov. 2, 1899. No. 31071 B.

Magnetic Flux.

Air-Gap and Core Distribution. W. Elwell Goldsborough. This second article treats of the magnetic flux and its effect upon the regulation and efficiency of dymano-electric machinery. Also discussion. 5500 w. Trans Am Inst of Elec Engs—Oct., 1899. No. 30932 D.

Magnetism.

The Relation of Magnetism to Electricity. Charles R. Gibson. A review of investigations, describing experiments. Ill. 3500 w. Elec, Lond—Oct. 27, 1899. No. 30628 A.

Magneto-Optics.

Magneto-Optic Rotation and Its Explanation by a Gyrostatic System. A discourse delivered at the Royal Inst. by Andrew Gray. Illustrates and describes investigations. 2800 w. Sci Am Sup—Dec. 2, 1899. Serial. 1st part. No. 31116.

Ohm's Law.

Ohm's Law According to the Vibration Theory (Das Ohm'sche Gesetz nach der Vibrations Theorie). Rudolf Mewes. A mathematical examination of the vibration theory of resistance as compared with the observed facts, showing that Ohm's is in accordance with the equations for mechanical work. 1500 w. Elektrochemische Zeitschr—Nov., 1899. No. 31076 G.

Phase-Difference.

Means for Producing Large Differences in Phase (Ueber Mittel zur Erreichung Crosser Phasenverschiebung). J. Görner. A mathematical discussion, with diagrams showing several methods applicable in practice. The applications of the methods are shown in the Hartmann & Braun meter. 2500 w. Elektrotech Zeitschr—Oct. 26, 1899. No. 31069 B.

Radiography.

A Simple Form of Influence Machine for X-Ray Work. William Cotton. Abstract from the *Bristol Medico-Chirurgical Journal.* Describes a sectorless Wimshurst machine and gives the results obtained. 4000 w. Elect'n, Lond—Oct. 27, 1899. No. 30632 A.

Radiograph Tube with Cool Anti-Cathode (Ampoule Radiographique à Anticathode Froide). MM. Buguet and Chabaud. A communication to the French Academy describing a method of cooling the terminal in a Crookes tube by means of a circulation of water or mercury. 1000 w. Comptes Rendus—Oct. 16, 1899. No. 31011 D.

The Pidgeon Influence Machine. Illustrates and describes a machine adapted for X-ray purposes. 2000 w. Elec Rev, Lond—Nov. 10, 1899. No. 30859 A.

Sparking.

A Discussion of Sparking in the Continuous-Current Dynamo (Beurtheilung der Gleichstrommaschinen in Bezug auf die Funkenbildung). Heinrich Isler. A mathematical treatment reviewing especially the recent theories of Dr. Fischer-Hinnen. Two articles, 6000 w. Elektrotech Zeitschr—Oct. 12, 19, 1899. No. 31062 each B.

An Analysis of Spark Discharges (Analyse von Funkenentladungen). Jul. H. West. Illustrated with many illustrations made in the mutoscope by continuous photography, showing the action of successive sparks. The Wehnelt interrupter was used. 3000 w. Elektrotech Zeitschr—Oct. 26, 1899. No. 31068 B.

GENERATING STATIONS.

Accumulators.

Computations for Equalizing Accumulators (Beitrag zur Berechnung von Buffer batterien). G. Brandt. A discussion of the method of computing the size of storage battery for equalizing the load in a traction power house, based upon the experiments of Siemens & Halske. 3000 w. Elektrotech Zeitschr—Oct. 19, 1899. No. 31066 B.

Measurement of the Internal Resistance of Accumulators. E. C. Remington. Explains method used by the writer, suggesting modifications that would probably work as well. 1500 w. Elec Rev, Lond—Oct. 20, 1899. No. 30531 A.

The Majert-Accumulator (Der Majert-Akkumulator). A. Wilke. With many illustrations showing the details of manufacture of the lead plates, including the special machinery for forming the cellular surface. Tables of data of capacity and endurance are given. 3500 w. Elektrotech Zeitschr—Nov. 9, 1899. No. 31074 B.

Brooklyn, N. Y.

Brooklyn's Modern Electric Light Station. Illustrates and describes the generating plant of the Kings County Electric Light and Power Company. 3400 w. Elec Rev, N. Y.—Nov. 22, 1899. No. 30920.

The New Station of the Kings County Electric Light and Power Co. George T. Hanchett. Illustrated detailed description. 1700 w. Elec Wld & Engr—Nov. 25, 1899. No. 30961.

Brushes.

Brush Rocker Details and Bearings. E. K. Scott. Illustrated description of various arrangements. 1200 w. Elec Rev, Lond—Oct. 27, 1899. No. 30630 A.

Cost.

Cost of Central Station Plant. Gives a table indicating what the writer considers should be sizes of the plant for towns of various populations, and the cost. 900 w. Elec Rev, Lond—Nov. 17, 1899. Serial. 1st part. No. 30973 A.

The Cost of Electric Energy in 1898. A. P. Haslam. An analysis of results in England. 2500 w. Elec, Lond—Oct. 20, 1899. Serial. 1st part. No. 30627 A.

Direct Current.

Capacity Limits in Direct-Current Machines. Alton D. Adams. A discussion of the maximum possible rate of work in electrical machinery. 1200 w. Eng News—Nov. 23, 1899. No. 30916.

Dynamos.

Low-Voltage Dynamos. E. Kilburn Scott. Illustrated discussion of a few designs. 800 w. Elect'n, Lond—Oct. 20, 1899. No. 30526 A.

Dynamo Testing.

Methods of Dynamo Testing. Considers the indicator, the calibrated motor, and the stray-power methods. 1700 w. Engr, U. S. A.—Nov. 1, 1899. No. 30595.

Generators.

Double Voltage and Current Generators. Alton D. Adams. States the advantages of generators that are able to deliver their output as either direct or alternating current, or a part in each. 1200 w. Elec Wld & Engr—Nov. 11, 1899. No. 30728.

Switchboard Connections and Synchronizing Arrangements for Polyphase

Generators. Illustrates and describes several arrangements used by the Westinghouse Elec. & Mfr. Co. 2500 w. Am Elect'n—Nov., 1899. No. 30601.

Leicester, Eng.

The Leicester Electricity Works. Illustrated detailed description of the first works in England equipped entirely with the inductor type of alternator. 2400 w. Elec Eng, Lond—Oct. 20, 1899. No. 30534 A.

Lighting Plant.

South Shields Corporation Electricity Works. Illustrated description of the installation for electric lighting. 2200 w. Elec Rev, Lond—Nov. 3, 1899. No. 30776 A.

Motive Power.

The Generation and Electrical Distribution of Motive Power. John S. Raworth. Read before the Manchester Assn. of Engs. An explanation of the extent to which electric power may be economically applied to the driving of machines, and how the various problems may be solved. 3800 w. Engng—Nov. 3, 1899. No. 30753 A.

Parallel Driving.

The Parallel Connection of Alternators Driven by Gas Engines (Das Parallelschalten von Wechselstrommaschinen, die durch Gasmaschinen Betrieben Werden). G. Dettmar. Showing how the alternators may be synchronized by the use of a magnetic brake acting on the fly wheel of the gas engine. 2500 w. Elektrotech Zeitschr—Oct. 19, 1899. No. 31065 B.

Penig, Saxony.

The Municipal Electrical Works at Penig (Das Städtische Elektrizitätswerk in Penig). Dr. R. Rühlmann. A general description of the plant by which the power of the river Mulde is utilized for light and power-supply of the city of Penig. 5000 w. Zeitschr d Ver Deutscher Ing—Oct. 28, 1899. No. 31032 D.

Poland.

Warsaw, Poland, Central Station Plant. Reviews the report of W. H. Lindley, who was employed to investigate every detail, giving extracts. Part first discusses the advantages and disadvantages of direct and alternating currents. 3300 w. Elec Wld & Engr—Nov. 4, 1899. Serial. 1st part. No. 30586.

Powder Works.

The Light and Power Plant of the California Powder Works. Wyatt H. Allen. Illustrated description. 2400 w. Elec Wld & Engr—Nov. 11, 1899. No. 30726.

Power Station.

A New Electric Power Station, Woburn, Mass. L. R. Wallis. Illustrated description of a station containing novel features, which serves current for public and private lighting, street-railways and manufacturing purposes, to a territory of 30,000 population and 100 miles of streets. 2500 w. Eng Rec—Nov. 4, 1899. No. 30649.

Rheinfelden.

The Hydro-Electric Plant at Rheinfelden. Detailed description. 3400 w. Engng—Nov. 10, 1899. No. 30872 A.

Steam Dynamo.

See Mechanical Engineering, Steam Engineering.

Test.

Test of a 300-Kilowatt Direct-Connected Railway Unit at Different Loads. Edward J. Willis. A test of the steam, water, and coal consumption and electrical output. 1000 w. Trans Am Inst of Elec Engs—Oct., 1899. No. 30933 D.

HEATING AND WELDING.

Welding.

Electric Welding and Metal Working (Elektrische Schweissung und Metallbearbeitung). Hermann Lemp. Mainly devoted to a description of the apparatus and methods of Prof. Elihu Thomson. 3500 w. Elektrochemische Zeitschr—Nov., 1899. No. 31077 G.

LIGHTING.

Arc Lamps.

Enclosed Arc Lamp Statistics. L. B. Marks. Records of thirty-six central stations. 600 w. Elec Wld & Engr—Nov. 4, 1899. No. 30587.

Transformers for Series Arc Light Circuits. A statement of the present state of the art of operating alternating-current arc lamps in series, as given in patent specification granted to Waldo A. Layman and Ferdinand Schwedtmann. 2000 w. W Elect'n—Nov. 18, 1899. No. 30905.

Candle-Power.

Mean Spherical Candle-Power. Wilbur M. Stine. An examination of the theory of mean spherical and mean hemispherical candle-power, and the methods of calculating those qualities. 2000 w. Elec Wld & Engr—Nov. 18, 1899. No. 30810.

Capitol.

Electric Lighting in the Albany Capitol. Illustrates and describes the work. 2000 w. Arch Rec—Oct.-Dec., 1899. No. 30733 C.

Incandescent Lamps.

The Advantages of Long Filaments in Incandescent Lamps. An explanation of the effect on high resistances, and discussion of the material used. 1800 w. Am Elect'n—Nov., 1899. No. 30600.

The High Voltage Lamp. A review of the present types now on the market. Ill. 600 w. Elect'n, Lond—Nov. 17, 1899. Serial. 1st part. No. 30978 A.

The Photometry of Incandescent Lamps. Arthur J. Rowland. Describes a special plan for readily procuring results, and the apparatus necessary for the purpose. Ill. 2200 w. Jour Fr Inst—Nov., 1899. No. 30605 D.

Light Company.

Allegheny County Light Company. An account of the works supplying the cities of Pittsburg and Allegheny with electric light. Ill. 2200 w. Engng—Nov. 10, 1899. No. 30873 A.

Lighting Plant.

See Generating Stations.

Standards.

Plea for a Working Standard of Light. S. Everett Doane. Note and discussion. 4200 w. Trans Am Inst of Elec Engs—Aug. and Sept., 1899. No. 30542 D.

Systems.

Public Lighting Systems. Editorial review of various arc-lighting systems. 2300 w. Elect'n, Lond—Oct. 20, 1899. No. 30527 A.

MEASUREMENT.

Meter.

Slippage Meter (Ueber Schlüpfungszähler). R. Seeman. Describing the Siemens & Halske device, consisting of separate counters on generator and motor. with attachment for simultaneous starting and stopping. 3000 w. Elektrotech Zeitschr—Nov. 2, 1899. No. 31070 B.

Resistance.

The Nalder Portable Apparatus for Measuring Feeble Resistances (Appareil Portatif Nalder pour la Mesure des Faibles Résistances). M. Aliamet. Describing an improvement over the Wheatstone bridge, which avoids the errors due to the resistances of contact. 1000 w. L'Electricien—Oct. 28, 1899. No. 31086 B.

POWER APPLICATIONS.

Cranes.

Electric Cranes. Illustrates both movable and stationary cranes to which electric power has been applied. 1600 w. Elec Rev, Lond—Nov. 17, 1899. Serial. 1st part. No. 30974 A.

Electric Traveling Crane of 35 tons Capacity (Pont Roulant Electrique de 35 Tonnes). A powerful 3-motor crane of 16 metres span, the details of which are fully shown in the illustrations. 1000 w. 1 plate. Génie Civil—Oct. 21, 1899. No. 31002 D.

Electrical Equipment.

See Marine Engineering.

Electric Driving.

Boring and Milling Machine, Electrically Driven (Bohr und Fräsmaschine mit Elektrischem Antriebe). Giving plan and elevation of a large and conveniently arranged tool, showing the adaptability of the electric motor to machine tool driving. 1000 w. Zeitschr d Ver Deutscher Ing—Oct. 7, 1899. No. 31025 D.

Electric Power.

See Mining & Metallurgy, Mining.

The Direct Driving of Machine Tools by Means of Polyphase or Multiphase Currents. Extracts from paper by O. Lasche, presented to the Berlin Soc. of Civ. Engs. Part first gives an illustrated description of the motor. 2500 w. Prac Engr—Nov. 10, 1899. Serial. 1st part. No. 30868 A.

Factory Transmission.

Transmission of Power in Factories. Discusses points relating to the application of motors for machine driving. 2400 w. Elec Rev, Lond—Nov. 3, 1899. No. 30775 A.

Power Plant.

See Generating Stations.

Speed Regulation.

Elements of Design Favorable to Speed Regulation in Plants Driven by Water Power. Allan V. Garratt. Describes those peculiarities of design which have a special bearing on speed regulation. Also discussion. 16700 w. Trans Am Inst of Elec Engs—Aug. and Sept., 1899. No. 30540 D.

Motor Speed Regulation. Alton D. Adams. Calling attention to the need of efficient means of regulation in variable speed motors. Discussion. 1400 w. Trans Am Inst of Elec Engs—Aug and Sept., 1899. No. 30543 D.

TRANSMISSION.

Conductors.

The Computation of Partially Fed Electric Conductors (Berechnung Einseitig Gespeister Elektrischer Leitungen). A. Hecker. A development of formulas intended to enable the computation of the most economical cross section. Two articles, 4500 w. Deutsche Zeitschr f Elektrotechnik—Oct. 15, Nov. 1, 1899. No. 31078 each G.

Discussion.

Some Notes on Electric Power Transmission. A report of statements at the Institution of Civil Engineers, by W. B. Esson, W. E. Ayrton, G. Forbes, Alexander Siemens, and others. 1200 w. Eng Rec—Nov. 18, 1899. No. 30843.

Polyphase.

The Line Losses of Polyphase Trans-

mission. George T. Hanchett. An attempt to reconcile the varying results advanced by conceded authorities and to show how each is obtained. 1800 w. Am. Elect'n—Nov., 1899. No. 30602.

MISCELLANY.

Accidents.

First Help to the Injured in Electrical Accidents (Anleitung zur Ersten Hülfeleistung bei Unfällen in Elektrischen Betrieben). The rules issued by the German Elektrotechnical Society, with illustrations of the method of inducing artificial respiration. 1000 w. Elektrotech Zeitschr—Oct. 19, 1899. No. 31064 B.

Anniversary.

The Seventy-fifth Anniversary of the Franklin Institute from an Electrical Standpoint. Edwin J. Houston. Reviews the progress and the part played by the Institute. 8000 w. Jour Fr Inst—Nov., 1899. No. 30604 D.

Congress.

The Electrical Congress at Como (Der Elektriker-Kongress in Como). A general report of the Congress with abstracts of the papers presented. 5000 w. Elektrotech Zeitschr—Oct. 12, 1899. No. 31061 B.

Physiological Effect.

Death by Electric Discharges (La Mort par les Décharges Electriques). MM. Prevost and Battelli. A report upon experiments made upon dogs, rabbits and guinea pigs, at the University of Geneva, with details of the effects of currents of various kinds. Oct. 23, 1899. No. 31013 D.

Switzerland.

Electrical Engineering in Switzerland. General consideration of the development of electrical enterprise. 3000 w. Engr, Lond—Oct. 27, 1899. No. 30620 A.

Volta.

Volta and the Voltaic Cell. Extracts from a lecture delivered in Como, by Prof. Augusto Righi. 4500 w. Elec Rev, Lond—Oct. 27, 1899. No. 30631 A.

GAS ENGINEERING

Acetylene.

The Action of Acetylene on the Oxides of Copper. F. A. Gooch and De Forest Baldwin. A report of investigations. 1800 w. Am Jour of Sci—Nov., 1899. No. 30553 D.

The 1899 Acetylene Congress at Nurnberg. Brief account of this meeting with abstracts of papers presented. 2500 w. Engr, Lond—Nov. 17, 1899. No. 30994 A.

The Explosive Side of Acetylene. Frederick H. McGahie. On the explosive limits and the conditions under which acetylene can be used with safety. 2800 w. Sci Am Sup—Dec. 2, 1899. No. 31119.

The Purification of Acetylene by Means of Chloride of Lime. Discusses the necessity of purification, the methods, and results. 2500 w. Engr, Lond—Nov. 3, 1899. No. 30756 A.

Address.

Presidential Address of Mr. A. C. Humphreys at the Annual Meeting of the American Gas Light Association. Discusses important subjects in connection with the gas industry. 5400 w. Jour Gas Lgt—Oct. 31, 1899. No. 30693 A.

Benzol.

Estimation of Benzol in Illuminating Gas. Otto Pfeiffer. Summary from the *Journal für Gasbeleuchtung*. Describes old methods of estimating and also the author's method. 2800 w. Gas Wld—Nov. 4, 1899. No. 30772 A.

Explosion.

Explosion at Manchester Corporation Gas Works. An illustrated account of an explosion, resulting in the death of the manager, Mr. G. E. Stevenson, and the injury of others. Also a sketch of Mr. Stevenson's life. 4500 w. Gas Wld—Nov. 4, 1899. No. 30773 A.

Gas Firing.

See Mechanical Engineering, Steam Engineering.

Gas Works.

The Gas Works at Ponce, Puerto Rico. D. L. Hough. Brief historical account of the gas business in Puerto Rico. 4500 w. Am Gas Lgt Jour—Nov. 13, 1899. No. 30744.

Governors.

Notes on the Working of a Self-Loading Governor. W. Whatmough. Read before the Manchester Dist. Inst. of Gas Engs. Gives results of the working at the Heywood Gas Works. 2400 w. Gas Eng's Mag—Nov. 10, 1899. No. 30967 A.

Liquefaction.

Compression and Liquefaction of Gases. Arthur L. Rice. Historical and scientific review. 4500 w. Trans Am Soc of Mech Engs, No. 829—Dec., 1899. No. 30885 C.

Meters.

Gas Supply by Automatic Meter. H. O. Eldridge. Read at meeting of So. Dist. Assn. of Gas Engs. and Mgrs.,

England. Also discussion. Outlines the conditions and success attained at Tottenham. 5500 w. Gas Wld—Nov. 11, 1899. No. 30856 A.

The Prepayment Meter System. Part first deals with its history and development. 1800 w. Gas Eng's Mag—Nov. 10, 1899. Serial. 1st part. No. 30966 A.

Municipal Works.

See Civil Engineering, Municipal.

Office.

The Manager's Town Office. N. H. Humphreys. Read before the So. Dist. Assn. of Gas Engs. and Mgrs., England. Recommendations helpful in advancing the business of the gas industry. 4800 w. Gas Wld—Nov. 11, 1899. No. 30855 A.

Photometry.

Some Experiments with the Edgerton Standard. Rollin Norris. Read before the Am. Gas Lgt. Assn. Detailed account of experiments made to find out how reliable is this standard. 4800 w. Am Gas Lgt Jour—Nov. 6, 1899. No. 30666.

Retorts.

Inclined Retorts. B. W. Smith. Read before the Midland Assn. of Gas Mgrs. Describes the operation of the inclined retorts at the Smethwick gas works. 3000 w. Gas Wld—Oct. 28, 1899. No. 30615 A.

Notes on the Heating of Gas Retorts. George Helps. Read before the Midland Assn. of Gas Mgrs. Discusses systems of firing, recuperators, waste gases, etc. 4000 w. Gas Wld—Oct. 28, 1899. No. 30614 A.

Retort Heating. G. P. Lewis. Observations on some points brought out in a recent paper by G. Helps. 1700 w. Gas Wld—Nov. 18, 1899. No. 30975 A.

Water Gas.

An Outline Description of Carburetted Water-Gas Manufacture. John M. Rusby. Ill. 3000 w. Stevens Ind—Oct., 1899. No. 30555 D.

Carburetted Water Gas as a Coal Gas Auxiliary. A. G. Glasgow. Read before the Am. Gas Lgt. Assn. Considers works of sufficient size for the dual system of production, and suggests how the ultimate result of joint production may be anticipated for comparison with either system singly. 2500 w. Am Gas Lgt Jour—Nov. 13, 1899. No. 30743.

Water Gas (Wassergas). Dr. Gerdes. A general discussion of the composition and properties of water gas, with a description of a complete plant as constructed by Julius Pintsch, of Berlin. 4500 w. Zeitschr d Ver Deutscher Ing—Nov. 11, 1899. No. 31037 D.

Wolverhampton.

An Example of Gas Engineering Work from Wolverhampton. Describes an interesting example of modern gas engineering. 2700 w. Jour Gas Lgt—Oct. 31, 1899. No. 30692 A.

Zurich.

The New Gas Works of the City of Zürich at Schlieren (Das Neue Gaswerk der Stadt Zürich in Schlieren). A. Weiss. A complete account of the new gas works constructed in an outlying suburb, since the consolidation of the old city of Zürich with the surrounding districts. Serial. Part I. 2000 w. 1 plate. Schweizerische Bauzeitung—Oct. 28, 1899. No. 31046 B.

MARINE AND NAVAL ENGINEERING

Armor-Clad.

The Modern Armor-Clad. Translated from *Le Monde Moderne*. Reviews the history of the armor-clad ship-of-war, and the progress in the manufacture of armor plates and projectiles. Ill. 3500 w. Sci Am Sup—Dec. 2, 1899. Serial. 1st part. No. 31115.

Armor Plates.

American Armor Plate for a Russian Battleship. Illustrates recently tested armor plates manufactured by the Carnegie Co., giving an account of results. 900 w. Sci Am—Nov. 25, 1899. No. 30930.

Krupp Armor-Plate Tests. Illustrated description of recent tests. 600 w. Sci Am Sup—Dec. 2, 1899. No. 31118.

Automatic Sight.

An Automatic Sight with a Maximum and Minimum Height Cam. H. C. Dunlop. Gives directions for cutting a cam that shall give the proper angles of elevation to the gun at all heights of tide. Ill. 1000 w. Jour U. S. Art—July-Aug., 1899. No. 30660 D.

Ballistic Table.

New Ballistic Table for Direct Fire. James M. Ingalls. Gives ballistic tables for direct fire, based on the quadratic law of resistance. 1800 w. Jour U. S. Art—July-Aug., 1899. No. 30659 D.

British Shipping.

British Merchant Shipping. Editorial on the effect of the withdrawal of the fleet for army service, which aggregated nearly 630,000 tons. 1700 w. Engng—Oct. 27, 1899. No. 30618 A.

Bulkheads.

Beam Formulæ Applied to a Vertically

Stiffened Bulkhead, with Some Results. No. 6. H. F. Norton. A mathematical analysis. Plate. 3500 w. Soc of Nav Archts & Marine Engs—Nov., 1899. No. 30825 E.

Cable Ship.

The New Cable-Ship "von Podbielski." Describes a ship owned by Germany, recently launched at Port Glasgow. 2000 w. Elect'n, Lond—Nov. 17, 1899. No. 30976 A.

Coaling.

Coaling Vessels at Sea. No. 1. Spencer Miller. Reviews various plans that have been suggested and describes the author's experiments with the Miller conveyor on the U. S. S. Marcellus. Ill. 8000 w. Soc of Nav Archts & Marine Engs—Nov., 1899. No. 30820 E.

Cruisers.

Designs for the Denver Class, Sheathed Protected Cruiser. No. 10. Philip Hichborn. A description of the sheathed protected cruisers provided for in the last appropriations for increase of the U. S. Navy. 9 plates. 2500 w. Soc of Nav Archts & Marine Engs—Nov., 1899. No. 30829 F.

The Dutch Cruiser Noord Brabant. Illustrates this vessel and its engines, giving a brief description. 400 w. Engr, Lond—Nov. 10, 1899. No. 30866 A.

Electric Equipment.

Application of Three-Wire System to Marine Electric Plants. Cecil P. Poole. Discusses several plans, describing the arrangements. Ill. 1600 w. Marine Engng—Nov., 1899. No. 30612 C.

The Electrical Equipment of the Largest Ship Afloat. An illustrated description of the electric lighting, electric motor and telephone systems on the steamship "Oceanic." 2000 w. Am Elect'n—Nov., 1899. No. 30598.

The Electric Plants of the Battleships Kearsarge and Kentucky. No. 4. J. J. Woodward. Description of the plants with a statement of the duties performed. 20 plates. 22000 w. Soc of Nav Archts & Marine Engs—Nov., 1899. No. 30823 F.

Engines.

The S. S. America Maru. Illustrated description of the triple-expansion engines. 1000 w. Engr, Lond—Oct. 27, 1899. No. 30623 A.

Gun Carriages.

The 15 Cm. Marine Carriage and the Krupp Tilting Carriage (Die 15 Cm. Schiffslaffeten und die Kruppsche Wiegenlaffete). J. Castner. Illustrated description of recent German gun-carriages, with especial reference to wide range of movement, and recoil bearings for rapid-fire. 3000 w. Stahl and Eisen—Nov. 1, 1899. No. 31054 D.

Lighthouses.

A Circular Steel Light-Tower at Sturgeon Bay Canal, Wisconsin. Illustrated description of a new type of light-house, favored because of its simplicity, small cost and lasting qualities. 700 w. Eng News—Nov. 9, 1899. No. 30697.

Methods of Revolving the Optical Apparatus for Lighthouses. D. P. Heap. Illustrated description. 2200 w. Sci Am—Nov. 25, 1899. No. 30929.

Merchant Marine.

Our Merchant Marine upon the Oceans. George F. Edmunds. Discusses ways of increasing foreign trade and of putting the carrying trade in the hands of the United States as far as its own products are concerned. 2500 w. Marine Rev—Nov. 2, 1899. No. 30664.

Power Formulae.

The Admiralty Co-efficient with Facts Gleaned from Torpedo Boat Steam Trials. William A. Fairburn. Shows that as the speed of vessels increases, the flaws in all power formulæ become more pronounced, and discusses their value. 4000 w. Marine Rev—Nov. 9, 1899. No. 30742.

Rudders.

On the Action of the Rudder, with Special Reference to the Motion of the Ship While the Helm Is Being Put Over. No. 14. William F. Durand. Collection of data and account of experimental investigations. Mathematical. 12 plates. 4200 w. Soc of Nav Archts & Marine Engs—Nov., 1899. No. 30833 E.

Sheathing.

Notes on Sheathing the U. S. S. Chesapeake. No. 7. Lloyd Bankson. Describes the process of sheathing this steel vessel with wood. 3 plates. 1200 w. Soc. of Nav. Archts & Marine Engs—Nov., 1899. No. 30826 E.

Shipbuilding.

A New England Ship Building Industry. Illustrates and describes the plant of the Fore River Engine Co., at Weymouth, Mass. 2000 w. Marine Rev—Nov. 2, 1899. No. 30663.

Ship Fittings.

Novelties in Ship Fittings. No. 11. R. M. Watt. Illustrates and describes a safety electric water-tight door, asbestos sheathing, metal folding berth, and metal skylight. 5000 w. Soc of Nav Archts & Marine Engs—Nov., 1899. No. 30830 E.

Ships' Boats.

Suggestions as to Improved Appliances for Launching Ships' Boats. No. 3. John Hyslop. Discusses davits and the

means of operating them, also other appliances, and the need of improvement. Ill. 4200 w. Soc of Nav Archts & Marine Engs—Nov., 1899. No. 30822 E.

Shipyards.

Overhead Cranes, Staging, and Riveter-Carrying Appliances in the Shipyard. No. 9. James Dickie. Detailed description of these appliances. 6 plates. 1600 w. Soc of Nav Archts & Marine Engs—Nov., 1899. No. 30828 E.

System of Work in a Great Lake Shipyard. No. 8. W. I. Babcock. Describes the practice of the Chicago Ship-Building Company as applied to the ordinary lake bulk freight vessel of large size. 20 plates. 4700 w. Soc of Nav Archts & Marine Engs—Nov., 1899. No. 30827 E.

Speed Trials.

Progressive Speed Trials of the U. S. S. Manning. No. 12. Cecil H. Peabody. Observations taken during the tests and analysis of progressive speed trials. Plates. 2200 w. Soc of Nav Archts & Marine Engs—Nov., 1899. No. 30831 E.

Steamships.

Steamship Ponce for Regular Service between New York and Porto Rico. Illustrates and describes this large new freight and passenger steamer, of the spar deck type. 500 w. Marine Engng—Nov., 1899. No. 30611 C.

Steel Steamer.

A Modern Lake Lumber Carrier. An Illustrated description of the steel steamer Jessie Spalding, recently built at West Bay City, Mich. 2000 w. Marine Rev—Nov. 2, 1899. No. 30665.

Steering.

On the Steering of Ships and the So-Called "Patent Ship Steering Gear." C. W. Suppan. Reprint from *Zeitschrift des Oesterr Ingenieur und Architekter-Vereins.* Treats of the rudder and steering gear, giving illustrated description of the mechanical apparatus named. 3000 w. Ir & St Trds Jour—Nov. 11, 1899. No. 30919 A.

Submarine Boat.

Tests of the Holland Submarine Boat. Brief notice of recent tests, with description of the electrical equipment. Ill. 800 w. Elec Wld & Engr—Nov. 4, 1899. No. 30588.

Topography.

Coastal Topography of the United States. Oscar C. S. Carter. An interesting and general description, with illustrations of special portions. 7000 w. Pro of Engs' Club of Phila—Oct., 1899. No. 30881 D.

Torpedo Boats.

Tactical Considerations Involved in Torpedo Boat Design. No. 13. A. P. Niblack. Discusses the characteristics of these boats, considered especially in relation to their operation. 4500 w. Soc of Nav Archts & Marine Engs—Nov., 1899. No. 30832 E.

Transports.

The Transport of Troops. Illustrates the Castle Liner "Kildonan Castle" as a troop-ship, considering its fittings as ideal for this purpose. 1000 w. Engng—Nov. 17, 1899. No. 30983 A.

Turrets.

A Discussion of the Superimposed Turret for Warships. Presents the arguments in favor and against the system. 1400 w. Sci Am—Nov. 25, 1899. No. 30928.

Schneider-Canet Naval Turrets. Illustrated detailed descriptions of these turrets and their operation. 2500 w. Sci Am Sup—Nov. 18, 1899. No. 30788.

U. S. Navy.

Comprehensive Scheme of Naval Increase. A. M. Bailey. From the *N. Y. Sun.* Discussing the vessels needed to complete the present equipment and furnish the country the protection required. 5800 w. Marine Rev—Nov. 16, 1899. No. 30844.

Warships.

The Increasing Complications in Warships, and How Simple Arrangements Might be Adopted. No. 5. George W. Dickie. Calls attention to points where improvement in effectiveness and simplicity can be effected as compared with present practice. 5 plates. 7000 w. Soc of Nav Archts & Marine Engs—Nov., 1899. No. 30824 E.

Water-Tubes.

Causes for the Adoption of Water-Tube Boilers in the U. S. Navy. No. 2. George W. Melville. Considers the decision of the United States Government to use nothing but water-tube boilers a step in advance, giving reasons for opinions. 4500 w. Soc of Nav Archts & Marine Engs—Nov., 1899. No. 30821 E.

Water-Tube Boilers in Marine Service. I. W. Chubb. Brief discussion of the advantages and disadvantages of water-tube boilers. 1800 w. Prac Engr—Oct. 20, 1899. No. 30530 A.

Yachting.

Yachting on the Great Lakes. Waldon Fawcett. Illustrated description of the boats used in contests between the United States and Canada. 2000 w. Sci Am—Nov. 4, 1899. No. 30583.

MECHANICAL ENGINEERING

AUTOMOBILISM.

Acetylene Motor.

Actylene Motor Wagons and Carriages. Illustrates a victoria and the running gear of a standard truck for delivery wagons, operated by acetylene gas. 800 w. Sci Am—Nov. 11, 1899. No. 30678.

Auto Race.

An American Auto Race. Brief report of the race at Galesburg, Ill. Ill. 800 w. Auto Mag—Nov., 1899. No. 30549 C.

Bearings.

Axle Bearings. Myron and Frederick B. Hill. A study of the advantages and disadvantages of various bearings. Ill. 3000 w. Auto Mag—Nov., 1899. No. 30551 C.

Electric Vehicle.

The Electric Automobile. Félicien Michotte. Part first discusses the motors and accumulators. Ill. 2500 w. Auto Mag—Nov., 1899. Serial. 1st part. No. 30552 C.

Gurney Coach.

The First Motor Ride. John Grand Carteret. An account of a ride in a motor carriage in 1829. Ill. 1500 w. Auto Mag—Nov., 1899. No. 30550 C.

Italy.

Automobiles and their Future in Italy (Gli Automobili ed il loro Avvenire in Italia). Guiseppe Spera. A report to the Commissioner of Public Works, discussing the relation of the automobile to the improvement of highways and the possible competition of automobile traction with railways. 2000 w. Rivista Gen dell Ferrovie—Oct. 29, 1899. No. 31089 B.

Kerosene Motor.

The Secor Oil Motor. Hugh Dolnar. Reply to the criticisms of Mr. J. D. Lyon. 700 w. Am Mfr & Ir Wld—Nov. 9, 1899. No. 30721.

Motor Vehicles.

Motor Vehicles in the Stock Market. Editorial discussion and warning, considering the four kinds of motive power used, and reviewing the standing of the industry. 2000 w. Eng News—Nov. 2, 1899. No. 30687.

Two Novel Automobiles. Frank H. Mason. Describes two vehicles exhibited recently in Berlin, the Pieper double-motor carriage and the "Electra." 1200 w. Am Mfr & Ir Wld—Nov. 2, 1899. No. 30662.

Renault Car.

The Renault Motor-Voiturette. An illustrated description of an application of the De Dion motor to light motor-vehicles. 500 w. Ind & Ir—Nov. 3, 1899. No. 30755 A.

Steam Wagons.

A Short Account of Some Modern Steam Wagons. George A. Burls. Excerpt of paper read before the Civil and Mech. Engs. Soc. A general discussion of the efficiency, durability, power, speed, etc., of these vehicles, with table of data, and short discussion. 5000 w. Automotor Jour—Nov., 1899. No. 30968 A.

Steering Gears.

A Study of Steering Gears With Two Pivots. Mostly taken from some recent contributions to *La Génie Civil* and *Engineering*. Ill. 2000 w. Automotor Jour—Nov., 1899. No. 30969 A.

Warfare.

The Automobile in War. Edwin Emerson, Jr. Illustrates and describes the various automotor guns and gun-carriages, discussing their efficiency and utility. 3800 w. Auto Mag—Nov., 1899. No. 30548 C.

HYDRAULICS.

Brake.

The Design of Hydraulic Brakes (Sur le Tracé des Freins Hydrauliques). M. Vallier. A discussion of the proper proportions of hydraulic buffing cylinders for the absorption of the recoil force of artillery. 1800 w. Comptes Rendus—Nov. 6. 1899. No. 31016 D.

Impulse Wheels.

An Interesting Water-Wheel Application. Illustrated description of the impulse wheels set up in the force main from a pumping station, to furnish power for electric generation. 600 w. Eng Rec—Nov. 11, 1899. No. 30714.

Piping.

A Proposed Improved System of Hydraulic Piping. Walter Ferris. Illustrates and describes the writer's plan. Part first gives an outline of the scheme. 2500 w. Am Mach—Nov. 2, 1899. Serial. 1st part. No. 30571.

Power Plant.

Two-Phase Water-Power Development at Sherbrooke, Quebec. A brief illustrated description of the electric light and power plant, its power development, its equipment and distribution. 2700 w. Can Elec News—Nov., 1899. No. 30739.

Pressures.

High Hydrostatic Pressures and Their Application to Compressing Liquids; a New Form of Pressure Gauge. Francis H. Stillman. Describes methods and apparatus used. Ill. 2000 w. Trans Am Soc of Mech Engs, No. 848—Dec., 1899. No. 30903 C.

Pressure in Pipe Due to Stoppage of Flowing Liquid. George M. Peck. Discussion of subject. 600 w. Trans Am Soc of Mech Eng, No. 837—Dec., 1899. No. 30892 C.

Pumping Engines.

See Steam Engineering.

Turbines.

The Turbines of the Rheinfelden Power Plant (Die Turbinen der Kraftübertrágungswerke Rheinfelden). F. Prásil. Giving details of the construction and arrangement of the triple turbines at Rheinfelden of 840 h. p. each. 3500 w. Zeitschr d Ver Deutscher Ing—Oct. 7, 1899. No. 31024 D.

MACHINE WORKS AND FOUNDRIES.

Accounting.

An Automatic Cost Distributing and Accounting Plan. W. S. Rogers. Describes the plan as worked out and applied. 3000 w. Ir & Coal Trds Rev—Nov. 10, 1899. No. 30863 A.

Boiler Works.

The Boiler Shops of the Alsace Machine Works at Grafenstaden (Kesselschmiede der Elsässischen Maschinenbaugesellschaft in Grafenstaden). Illustrated description of a modern boiler works with especial reference to electrically operated tools and hydraulic riveting machinery. 3500 w. Zeitschr d Ver Deutscher Ing—Oct. 7, 1899. No. 31023 D.

Castings.

Casting Axle Boxes, Wheels, etc., on Chills. Walter J. May. Directions for a cheap way of preparing castings for certain applications. 700 w. Prac Engr—Oct. 20, 1899. No. 30529 A.

Skimming Gates. Eli H. Pearce. Suggestions for this work. Ill. 800 w. Foundry—Nov., 1899. No. 30939.

Sweeping a Large Spur Pinion. R. H. Palmer. Illustrated detailed description. 1400 w. Am Mach—Nov. 2, 1899. No. 30572.

Coke Consumption.

Coke Consumption in Iron Foundries. Walter J. May. Considers things affecting the quantity consumed. 1500 w. Prac Engr—Oct. 27, 1899. No. 30635 A.

Crane Beds.

Making Revolving Crane Beds. Joseph Horner. Illustrated description. Am Mach—Nov. 16, 1899. Serial. 1st part. No. 30784.

Cranes.

See Electrical Engineering, Power Applications.

Dividing Engines.

The Wurdemann Automatic Dividing Engine. C. L. Berger. Illustrates and describes an engine for automatically graduating the circles of astronomical and scientific instruments, which is of interest on account of novel features and its remarkable accuracy. 1000 w. Eng News—Nov. 2, 1899. No. 30684.

Drawing.

Parallel Ruler Attachments. William Pilton. Illustrated descriptions. 800 w. Am Mach—Nov. 16, 1899. No. 30785.

Drilling.

A Travelling Drilling Machine. Illustrated description. 500 w. Engr, Lond—Nov. 17, 1899. No. 31105 A.

Fluxes.

The Use of Fluxes in the Foundry. Walter J. May. On the few uses of fluxes and the general ignorance concerning why they are used. 800 w. Prac Engr—Nov. 10, 1899. No. 30869 A.

Flywheels.

A Broken Flywheel and How It Was Repaired. James McBride. Illustrates and describes the wheel and the method of repair which left it stronger than when first erected. 1600 w. Trans Am Soc of Mech Engs, No. 836—Dec., 1899. No. 30891 C.

A Note on Flywheel Designs. A. J. Frith. A study of the effect of the arms of a flywheel on its rim, and regarding the mutual proportions. 1400 w. Trans Am Soc of Mech Engs, No. 832—Dec., 1899. No. 30887 C.

Lamp Factory.

Baerrenberg Incandescent Lamp Factory. A brief illustrated description of works being erected for the manufacture of glow lamps by the Berrenberg process. 1600 w. Elect'n, Lond—Nov. 3, 1899. No. 30778 A.

Lathes.

A Lathe With Some New Features. Illustrates and describes the Le Blond lathe. 1500 w. Am Mach—Nov. 2, 1899. No. 30573.

Heavy Duplex Lathe. Illustrated description of a very powerful lathe for dealing with shafting of the heaviest class. 700 w. Engng—Oct. 27, 1899. No. 30617 A.

Hexagon Turret Lathe. Illustrated detailed description of a fine English tool,

exhibited by Alfred Herbert, Ltd., at the Crystal Palace. 5000 w. Engr, Lond—Nov. 17, 1899. No. 31102 A.

Machine Tools.

The Work of Machine Tools. An abridged translation of a paper contributed to the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale.* An account of investigations of Messrs. F. Hillier and Ch. Frémont. 2500 w. Engr, Lond—Nov. 17, 1899. No. 31106 A.

Manufacturing Plant.

The Works of the Bullock Electric Manufacturing Company. Illustrated description of new shops with electrically driven tools and an unusual system of electric transmission, allowing six changes of speed of tools without changing gears or using resistance. 1800 w. Eng Rec—Nov. 25, 1899. No. 30950.

Molding.

The Poole Molding Machine. Illustrated description of the machine and its work. 1500 w. Foundry—Nov., 1899. No. 30940.

Piecework.

Regarding Piecework. Editorial discussion of the advisability of adopting the piece-work system in railway shops. 1800 w. Ry & Engng Rev—Nov. 11, 1899. No. 30749.

Preston Works.

The Electric Railway and Tramway Carriage Works, Limited, Preston, Eng. Benjamin Sykes. Illustrated detailed description. 2800 w. Elec Eng. Lond—Nov. 10, 1899. No. 30857 A.

Punching.

Indexing Multiple Punching Machine. Illustrates and describes a machine for punching the parts of built-up columns, girders, etc., direct from the drawings and without templates or laying-out of any kind. 2500 w. Am Mach—Nov. 9, 1899. No. 30670.

The Werner Portable Punching and Cutting Machine. Illustrates and describes the machine and the general principle on which it works. 600 w. R R Gaz—Nov. 10, 1899. No. 30738.

Records.

Railway Map and Profile Records. V. K. Hendricks. Describes the practice on the Terre Haute & Logansport Ry., with additional suggestions. 2400 w. Pro of Ill Soc of Engs & Surv—1899. No. 30546 E.

Screw Machine.

Automatic Screw Machine. Illustrates and describes a fine English machine for producing all kinds of pins, collars, studs, washers, bushings, or turned work, and specially suited for the production of projectiles. 2000 w. Engng—Nov. 10, 1899. No. 30875 A.

Screw System.

Report on the Width of Nut for the New Metric Screw System (Bericht über die Frage der Schlüsselweiten zum Neuvem Metrischen Gewinde-System). An appendix to the report of the Zurich conference of 1898, discussing especially the width between opposite flat faces of nuts and bolt heads. 1800 w. Zeitschr d Oesterr Ing u Arch Ver—Oct. 27, 1899. No. 31020 B.

Shop Practice.

The Revolution in Machine Shop Practice. Henry Roland. A well and richly illustrated exposition of the adaptation of the turret to multiple-production of machine parts, either from the bar or castings, with consequent enormous reduction of costs. 3500 w. Engineering Magazine—Dec. 1899. No. 31093 B.

Shops.

The Shops of the Bethlehem Steel Company. Illustrations and descriptions of some of the notable tools used for machining the forgings. 2000 w. Mach, N. Y.—Nov., 1899. No. 30561.

Slide Rule.

The Slide Rule for Computing Gears for Screw Cutting. J. H. Gill. Describes the writer's way of selecting compound gears for thread cutting. 700 w. Am Mach—Nov. 16, 1899. No. 30786.

Slotting Machine.

Portable Slotting Machine. Illustrated description of an electrically-driven machine. 700 w. Engr, Lond—Nov. 17, 1899. No. 31104 A.

South Africa.

Some Notes on South African Foundries. James Cherrie. An account of a trip, with description of foundry work. 3000 w. Foundry—Nov., 1899. No. 30941.

Standardizing.

Standardizing in Engineering Construction. Sir B. C. Browne. Shows the fallacy of the labor party's attitude toward economy of production and the dangers of unionism, either of employers or workers; proves the identity of interest of capital and labor in reducing manufacturing cost, and urges co-operation between workmen and employers. 3000 w. Engineering Magazine—Dec., 1899. No. 31095 B.

Stanley Show.

Some Machine Tools at the Stanley Show. Illustrates and describes a variety of automatic machines exhibited. 6000 w. Engr, Lond—Nov. 17, 1899. No. 31103 A.

Swiss Works.

The Engineering Works of Escher, Wyss & Co. Description of works established in the town of Zurich in 1805, and now covering about 35 acres. 3300 w. Engng—Nov. 3, 1899. No. 30751 A.

Taper.

A Standard Taper for Twist Drills and Milling Tool Shanks (Ein Normalsystem für Spiralbohrer und Fräserkegel). H. Pasler. Discussing a proposed system similar to the Morse, for use with metric dimensions. 1800 w. Zeitschr d Ver Deutcher Ing—Nov. 11, 1899. No. 31036 D.

Tools.

An Endshaking Tool. Illustrated description of a tool used in watch-making. 600 w. Am Mach—Nov. 23, 1899. No. 30927.

British and American Machine Tools. Part first is a comparison of the conditions surrounding the trade. 2400 w. Engr, Lond—Oct. 27, 1899. Serial. 1st part. No. 30621 A.

Twist Drills.

The Limiting Size of a Twist Drill. On some experiments made by L. P. Breckinridge in 1888, with comments. Ill. 1000 w. Am Mach—Nov. 23, 1899. No. 30926.

Works Management.

Works Management for the Maximum of Production. J. Slater Lewis. A forcible definition of the practical condition of the British engineering trade, a critical discussion of the arguments for and against specialization and a depreciation of unreasoning extravagance in the campaign for reorganization. 3500 w. Engineering Magazine—Dec., 1899. No. 31092 B.

MATERIALS OF CONSTRUCTION.

Dynamograph.

A Metal Dynamograph. Paul Mellen Chamberlain. Describes this machine for testing cast-iron specimens. Ill. 700 w. Trans Am Soc of Mech Engs, No. 846—Dec., 1899. No. 30901 C.

Grindstones.

Experiments Upon the Strength of Grindstones (Versuche über die Festigkeit von Schleifsteinen). M. Grübler. Especially investigating the resistance of grindstones and emery wheels to the stresses due to centrifugal force, with description of the apparatus and results of tests. 4000 w. Zeitschr d Ver Deutscher Ing—Oct. 21, 1899. 31031 D.

Impact.

Impact. W. J. Keep. Showing the influence of impact upon test bars of various sizes. 3000 w. Trans Am Soc of Mech Engs, No. 847—Dec., 1899. No. 30902 C.

Preliminary Report on the Present State of Knowledge Concerning Impact Tests. W. Kendrick Hatt and Edgar Marburg. Presented at the annual meeting of the Am. Soc. of the Inter. Assn. for Test. Materials. 7000 w. Assn Bul No. 5—Oct., 1899. No. 30862 D.

Steel Balls.

Strength of Steel Balls. J. F. W. Harris. Gives an account of tests made at the Rose Polytechnic Inst. to determine the breaking strength. 700 w. Trans Am Soc of Mech Engs, No. 844—Dec., 1899. No. 30899 C.

Tensile Tests.

Impact Tensile Tests of Steel. Extracts from the paper of S. Bent Russell, with comments and editorial. 3300 w. Eng News—Nov. 16, 1899. No. 30800.

POWER AND TRANSMISSION.

Air Compressors.

The Intercooler on the Air Compressor. Frank Richards. On the value and efficiency of the intercooler, with suggestions. Ill. 1600 w. Am Mach—Nov. 9, 1899. No. 30671.

Compressed Air.

Compressed Air. J. J. Swann. Discusses the production, transmission and use. 5000 w. Sib Jour of Engng—Nov., 1899. No. 30906 C.

Dumping.

The O'Rourke Dumping Bucket. Illustrated description of a recently patented drop-bottom bucket. 1100 w. R R Gaz—Nov. 24, 1899. No. 30945.

Electric Driving.

See Electrical Engineering, Power Applications.

Factory Transmission.

See Electrical Engineering, Power Applications.

Horse Power.

On the Value of a Horse-Power. George I. Rockwood. Reports the discussion on the question at Worcester, Mass., in settling questions of water privileges. 4800 w. Trans Am Soc of Mech Engs, No. 850—Dec., 1899. No. 30904 C.

Pedal Power.

The Power Transmitted by a Pedal. Adapted from an article in *l'Industrie Velocipédique et Automobile.* Gives experiments and results. 1200 w. Automotor Jour—Nov., 1899. No. 30970 A.

Power Factor.

The Theory of the Power Factor.

Alexander Russell. An investigation attempting to show how the power factor is related to the shape of the waves of current and potential difference, and their relative positions. Mathematical. 1000 w. Elect'n, Lond—Nov. 3, 1899. Serial. 1st part. No. 30779 A.

Transport Appliances.

Mechanical Transport Appliances in Engineering Work. A. J. S. B. Little. A review of the means which reduce greatly the cost of engineering undertakings, either constructive or manufacturing, urging greater attention to their introduction and extension. The illustrations supplement the text by showing many instances of conveyor installations all over the world. 3000 w. Engineering Magazine—Dec., 1899. No. 31096 B.

SPECIAL MOTORS.

Acetylene Motor.

See Automobilism.

Entropy Diagram.

A New Graphical Method of Constructing the Entropy Temperature Diagram of a Gas or Oil Engine from Its Indicator Card. Henry T. Eddy. Explains the method. 2800 w. Trans Am Soc of Mech Engs. No. 831—Dec., 1899. No. 30886 C.

Gas Engines.

A Gas Engine and Fuel-Gas Producer Power Plant. Illustrated detailed description of the plant recently erected at the new shops of the Erie R. R. in Jersey City. 1000 w. Eng News—Nov. 23, 1899. No. 30913.

An Efficiency Test of a One Hundred and Twenty-five Horse-Power Gas Engine. C. H. Robertson. Illustrated description of the plant of the Merchants' Electric Lighting Co., of Lafayette, Ind., with data concerning the performance of the engines. 5000 w. Trans Am Soc of Mech Engs, No. 835—Dec., 1899. No. 30890 C.

Gas Engines and Producer Gas. Reports the results attained at the new power plant of the Erie R. R. at Jersey City, giving an illustrated description of the installation. 2800 w. Am Engr & R R Jour—Nov., 1899. No. 30560 C.

Gas Engine Design. E. W. Roberts. An explanation of the general principles. Ill. 2200 w. Mach, N. Y.—Nov., 1899. Serial. 1st part. No. 30563.

Gasoline.

Gasoline Engines in Pumping Plants. Gives the cost of operation of a number of plants supplying railway divisions. 2000 w. Eng Rec—Nov. 18, 1899. No. 30840.

Kerosene Motor.

See Automobilism.

STEAM ENGINEERING.

Boilers.

Corrosions and Cracks in Locomotive Boilers. Translation of an article by M. Desgeans, in the *Revue Générale des Chemins de Fer.* Illustrated discussions of defects and the causes. 3300 w. R R Gaz—Nov. 3, 1899. No. 30590.

Possible Economies in Steam Boiler Management. Walter B. Snow, in the *Boiler-maker.* Discusses the losses and their causes. 2800 w. Prac Engr—Oct. 27, 1899. No. 30637 A.

Boiler Trials.

Discussions Upon the Provisional and Amended Drafts of the Report of the Committee on the Revision of the Code of 1885, Relative to a Standard Method for Conducting Steam-Boiler Trials. 10800 w. Trans Am Soc of Mech Engs, No. 828—Dec., 1899. No. 30884 C.

Report of the Committee on the Revision of the Society Code of 1885, Relative to a Standard Method of Conducting Steam-Boiler Trials. Gives the code of 1899 with appendices. 25000 w. Trans Am Soc of Mech Engs, No. 827—Dec., 1899. No. 30883 D.

Chimney.

The Monumental Chimney of the La Bourdonnais Power House (La Cheminée Monumentale de l'Usine La Bourdonnais). G. Leugny. A fully illustrated description of the great chimney for the power-house of the Paris Exposition, with views showing various stages of the work. 2500 w. Revue Technique—Oct. 25, 1899. No. 31017 D.

Coal Calorimetry.

The Berthier Method of Coal Calorimetry. C. V. Kerr. Describes this method, stating its advantages. 2000 w. Trans Am Soc of Mech Engs, No. 841—Dec., 1899. No. 30896 C.

Condensing.

Central Steam Condensing Plants. Considers the advantages and disadvantages as compared with single condensation, and gives detailed description of such plants. Ill. 2800 w. Prac Engr—Oct. 27, 1899. Serial. 1st part. No. 30636 A.

Condensers and Condensing for Electric Power Stations. S. Payne. Read before the Manchester Soc. of Jun. Elec. Engs. Considers the importance of condensing, describing briefly the types of steam condensers and auxiliaries, and the application to electric power stations. 3800 w. Elec Eng, Lond—Nov. 17, 1899. No. 30972 A.

Corliss Engines.

New Corliss Engine for the Boston Elevated Railway Co. Illustrated detailed

description. 2800 w. Power—Nov., 1899. No. 30585.

Engine Test.

Test of a Cooper-Corliss Engine at Various Loads. Illustrated report of the efficiency of 1,000 H. P. compound condensing engine under the variable duty of electric railway service. 1300 w. Eng Rec—Nov. 18, 1899. No. 30841.

The Construction and Operation of Corliss Engines. Gives its history and an illustrated description of the machine and its operation. 18800 w. Engr, U. S. A.—Nov. 15, 1899. No. 30962.

The Corliss Engine in Great Britain. Part first gives an account of its pioneers, their work and opposition. Ill. 3300 w. Prac Engr—Oct. 27, 1899. Serial. 1st part. No. 30634 A.

Fuel.

Advantages of Coke Over Coal as a Fuel for Generating Steam. Arthur C. Freeman. Read at Montreal meeting of the New England Cotton Mfrs. Assn. States its advantages and gives suggestions for its management. 1200 w. Am Mfr & Ir Wld—Nov. 9, 1899. No. 30722.

Gas Firing.

Experiments on Using Gasoline Gas for Boiler Heating. Herman Poole. Gives details of experiments made in Philadelphia with a 60 h. p. boiler. 2700 w. Trans Am Soc of Mech Engs, No. 838—Dec., 1899. No. 30893 C.

Heat Transmission.

The Transmission of Heat Through Metals from Steam to Water. A. W. Richter. Illustrated description of tests made to furnish formulas for estimating the transmission of heat in boilers, feed-water heaters, etc. 4000 w. Eng Rec—Nov. 11, 1899. No. 30706.

Improvements.

The Improvement and Development of Boilers and Steam Engines. Thomas Begrie. Abstract of a paper read before the Mech. Engs. Assn., Johannesburg. A discussion of recent improvements and their results. 3000 w. Ir & Coal Trds Rev—Nov. 3, 1899. No. 30767 A.

Indicator Springs.

Testing Indicator Springs. D. S. Jacobus. Describes the method finally adopted for testing indicator springs and obtaining the correct scale to use for a given indicator card. 3500 w. Stevens Ind—Oct., 1899. No. 30557 D.

Liquid Fuel.

Kermode's Apparatus for Burning Liquid Fuel. Describes and illustrates a system where the oil is first vaporized by being mixed with hot air, which is supplied under pressure for the purpose. 1000 w. Engng—Nov. 17, 1899. No. 30984 A.

Mechanical Draft.

The Substitution of Mechanical Appliances for Chimney Draft (Der Ersatz der Dampfschornsteine durch Mechanische Zugmittel). R. Schenkel. With illustrations of numerous devices for producing mechanical draft in steam boiler plants, mainly taken from American practice. 5000 w. Zeitschr d Ver Deutscher Ing—Oct. 14, 1899. No. 31027 D.

Packings.

Friction of Steam Packings. Charles Henry Benjamin. Describes experiments made at the laboratories of the Case School. Ill. 1500 w. Trans Am Soc of Mech Engs, No. 839—Dec., 1899. No. 30894 C.

Power-House Engines.

The Steam Engine for the Electric-Traction Power-House. C. A. Hague. Displays forcefully the way in which the service differs from mill and marine practice and discusses the changes in design required by the unique and severe conditions. 3000 w. Engineering Magazine—Dec., 1899. No. 31097 B.

Pumping Engine.

Test of the Aurora Pumping Engine. L. P. Breckenridge. Gives method of making the tests and the principal results. 1700 w. Pro of Ill Soc of Engs & Surv—1899. No. 30545 E.

Test of Two Ten-Million-Gallon Pumping Engines at the Baden Pumping Station, St. Louis Water Works, June, 1899. John A. Laird. Illustrated detailed description with results of test. 2400 w. Trans Am Soc of Mech Engs, No. 840—Dec., 1899. No. 30895 C.

Purifier.

Apparatus for Purifying Feed-Water and Heating it to 100° C. (Epurateur Economique Détartrant l'Eau d'Alimentation des Chaudières et la Réchauffant à 100°). A description of the Granddemange heater and purifier; an open pan-heater for use with exhaust steam. 1000 w. Génie Civil—Nov. 4, 1899. No. 31007 D.

Slide Valves.

Friction Tests of a Locomotive Slide Valve. Frank C. Wagner. Describes tests made at the Rose Polytechnic Inst. 900 w. Trans Am Soc of Mech Engs, No. 843—Dec., 1899. No. 30898 C.

Smoke.

The Limits of Economy in Smoke Consumption (Die Kohlеersparnis der Rauchverbrennungsanlagen und deren Grenze). E. Nicolaus. An examination of the thermal conditions of smoke consumption, including gas-firing and the use of pul-

verized fuel. 2000 w. Gesundheits-Ingenieur—Nov. 15, 1899. No. 31043 B.

The Smokeless Combustion of Soft Coal. William Kent. Considers why smoke is produced and the remedy, with an illustrated description of a steam-boiler furnace patented by the writer. 1200 w. Stevens Ind—Oct., 1899. No. 30556 D.

Steam-Dynamo.

Vertical Steam Engine and Dynamo of 3000 h. p. (Stehende Dampfdynamomaschinen von 3000 PS.) A very fully illustrated account of the engines and generators built by Gebrüder Sulzer and the Allgemeine Elektrizitäts Gesellschaft for the Luisenstrasse station at Berlin. 2500 w. 3 plates. Zeitschr d Ver Deutscher Ing—Nov. 4, 1899. No. 31034 D.

Steam Engine.

The Steam Engine at the End of the Nineteenth Century. R. H. Thurston. A scientific study of the machine, presenting data illustrating the approximation attained to the ideal engine of Carnot. Illustrations and plates. 11300 w. Trans Am Soc of Mech Engs, No. 833—Dec., 1899. No. 30888 D.

Steam Turbines.

Presidential Address by the Hon. Charles A. Parsons, before the Institution of Junior Engineers. Dealing largely with steam turbines and their applications. 6000 w. Engr, Lond—Nov. 10, 1899. No. 30867 A.

Superheating.

The Application of Superheated Steam (Die Auwendung des Ueberhitzten Wasserdampfes). H. Hoff. Especially discussing the mechanical arrangements of superheaters of modern types. 1200 w. Zeitschr d Ver Deutscher Ing—Oct. 14, 1899. No. 31028 D.

Triple Expansion.

The New 500 h. p. Triple Expansion Engine of the Stockholm Electrical Works (Die Neue 500 Pferdige Dreifach-Expansionsmaschine des Stockholmer Elektrizitätswerkes). S. J. Ledin. A general view of the engine, also detail drawings, and data of tests, with indicator diagrams. 2500 w. Zeitschr d Ver Deutscher Ing—Oct. 28, 1899. No. 31033 D.

Turbines.

The Parsons Steam Turbine. An illustrated account of some of the applications of the steam turbine. 1400 w. Sci Am—Nov. 18, 1899. No. 30787.

Valves.

Something About Valves. W. H. Wakeman. Facts from the writer's experience. 1300 w. Am Mach—Nov. 9, 1899. No. 30672.

Vertical Engines.

Engines for the Sheffield Electric Tramways. H. W. Morley. Description, with illustrations, of engines of the slow-speed type. 1500 w. Engr, Lond—Oct. 27, 1899. No. 30622 A.

The Rigidity of Vertical Engines (Die Standfestigkeit der Stehenden Dampfmaschinen). P. Straube. With drawings of numerous forms of framing for vertical engines, comparing their respective advantages. 3000 w. Zeitschr d Ver Deutscher Ing—Oct. 21, 1899. No. 31030 D.

Water Tubes.

See Marine Engineering.

Winding Engine.

See Mining & Metallurgy, Mining.

MISCELLANY.

Aeronautics.

Count von Zeppellin's Dirigible Airship. Illustrates and describes the structure of this huge airship, being built on a float in Lake Constance. 1200 w. Sci Am Sup—Nov. 11, 1899. No. 30679.

Bicycles.

The Bicycle for War Purposes. B. F. S. Baden-Powell. Discusses its uses, the best type of machine, and the equipment required. Ill. 8000 w. Jour U. S. Art—July-Aug., 1899. No. 30661 D.

The Efficiency of Bicycles. R. C. Carpenter. Discussing the efficiency as a machine, dynamometer tests, etc. Ill. 3000 w. Sib Jour of Engng—Nov., 1899. Serial. 1st part. No. 30907 C.

Blue-Prints.

A Curved Glass Blue-Print Machine. Paul Mellen Chamberlain. Describes and illustrates a convenient machine. 300 w. Trans Am Soc of Mech Engs, No. 842—Dec., 1899. No. 30897 C.

Carbonic Acid.

The Liquefaction of the Carbonic Acid Produced by Breweries and Distilleries (Liquefaction de l'Acide Carbonique des Brasseries et Distilleries d'Alcool). An account of the Meuus method of recovering the waste carbonic acid gas of breweries, etc., and liquefying it for subsequent use. 1000 w. Moniteur Industriel—Nov. 11, 1899. No. 31084 E.

Education.

A Unique Departure in Engineering Education. Edward Orton. An account of the work at the Ohio State University, located at Columbus, Ohio. Ill. 2000 w. Sci Am Sup—Dec. 2, 1899. No. 31114.

Education of Machinists, Foremen, and Mechanical Engineers. M. P. Higgins. Outlines a special school for training.

12500 w. Trans Am Soc of Mech Engs, No. 834—Dec., 1899. No. 30889 D.

The Centennial Celebration of the Technical High School at Berlin (Zur Hundertjahr-Feier der Technischen Hochschule zu Berlin). Giving a history of the institution, with an account of its work and of the notable educators associated with it. 2500 w. Zeitschr d Ver Deutscher Ing—Oct. 21, 1899. No. 31029 D.

The Centennial Celebration of the Technical High School at Berlin (Jahrhundertfeier der Technischen Hochschule in Berlin). With the address of the Emperor of Germany, also the speeches at the unveiling of the Krupp and Siemens memorials, and illustrations of the statues. 3000 w. Stahl und Eisen—Nov. 1, 1899. No. 31052 D.

Energy.

Notes on the Commercial Transformation of Energy. Daniel W. Mead. A study of the transmission and transformation of energy. Also discussion. 10700 w. Pro of Ill Soc of Engs & Surv—1899. No. 30544 E.

Entropy Diagram.

See Special Motors.

Heat.

On "Specific Heat." An explanation, with illustrations. 3800 w. Locomotive—Oct., 1899. No. 30658.

Plow.

The Plow in Asia (La Charrue en Asie). H. Chevalier. A historical study of the development of plowing devices of the East, this paper being devoted to the plow in China and Japan. 1200 w. Génie Civil—Nov. 11, 1899. No. 31008 D.

Rust.

Cases of "Mysterious" Rusting. N. Monroe Hopkins. Describes machines suddenly coated with rust and investigates the causes. 1200 w. Sci Am—Nov. 11, 1899. No. 30677.

Telescope.

The Great Telescope of the Paris Exposition of 1900. Gives views showing the construction, with description. 1800 w. Sci Am—Nov. 4, 1899. No. 30584.

Trade Combinations.

The Strength and Weakness of the Trust Idea. John Graham Brooks. An acknowledgment of the merits which the trust can claim as an aid to organizing industry, and an arraignment of the abuses and evils which attend the craze for combinations. Full publicity and access to information is proposed as a remedy. 4500 w. Engineering Magazine—Dec., 1899. No. 31091 B.

Tuskegee.

Commercial Work by Students of Tuskegee Institute. Harry E. Thomas. An illustrated account of the work at this industrial school for the education of colored youth. 1400 w. Am Mach—Nov. 16, 1899. No. 30783.

Typesetting.

The Lanston Typesetting and Casting Machine. A description, with illustrations, of the character and operation of the Lanston "Monotype" machine. 1800 w. Eng News—Nov. 2, 1899. No. 30688.

Units.

Units of Measurement. W. Moon. A discussion of the systems of mechanical units in use. 700 w. Elec Rev, Lond—Nov. 3, 1899. Serial. 1st part. No. 30777 A.

MINING AND METALLURGY

COAL AND COKE.

Analysis.

The Examination of Combustibles by the Röntgen Rays (Untersuchung von Brennstoffen Mittels Röntgenstrahlen). F. Kotte. With reproductions of radiographs, showing the manner in which siliceous matter in the carbon is revealed. 1800 w. 2 plates. Stahl und Eisen—Nov. 1, 1899. No. 31055 D.

Coal Working.

Improved Methods of Bringing Down Coal in Prussia. After extracts by *Glückauf*, from the official report. Discusses blasting by mechanical rock-boring, explosives, igniters, etc.; also wedging. 1600 w. Col Guard—Nov. 3, 1899. No. 30761 A.

Improved Methods of Working Coal in Prussia. After extracts by *Glückauf* from the official report for 1898. Illustrates and describes several methods. 1200 w. Col Guard—Nov. 10, 1899. No. 30880 A.

Coke Consumption.

See Mechanical Engineering, Foundries.

Coke Handling.

The Mechanical Handling of Coke (Manutention Mécanique du Coke). J. Laverchère. Giving numerous illustrations of devices for handling gas-works coke, as installed in the United States and in France. 2000 w. 1 plate. Génie Civil—Oct 14, 1899. No. 31000 D.

New Zealand.

Coal Mining in New Zealand. Harri-

son F. Bulman. On the explosions in the mines, describing the most serious accidents, and giving other information. 1500 w. Col Guard—Nov. 17, 1899. No. 30987 A.

Prospecting.

Prospecting for Coal in Colorado. Arthur Lakes. How to distinguish the strata in which it may be found. Ill. 1900 w. Mines & Min—Nov., 1899. No. 30639 C.

Quenching.

A Dry Quenching Process for Coke. Illustrated description. 900 w. Ir & Coal Trds Rev—Nov. 3, 1899. No. 30766 A.

Separation.

The Separation of Coal and Other Light Minerals. Walter J. May. Describes an arrangement for water separation, and the use of jigging machines. 2000 w. Col Guard—Oct. 27, 1899. No. 30626 A.

Servia.

Coal in Servia. E. Heguer and J. Francois. From a communication to the Société des Ingénieurs des Mines du Hainaut. Descriptive account of the coal-fields and their working. 1100 w. Col Guard—Nov. 17, 1899. No. 30991 A.

South Africa.

The Coal Fields of South Africa. Illustrates and describes the Natal Navigation collieries in part first. 1000 w. Ir & Coal Trds Rev—Oct. 27, 1899. Serial. 1st part. No. 30616 A.

COPPER.

Copper Refining.

The Electrolytic Refining of Copper at Anaconda, Montana. E. C. Sickles. Brief sketch of the general process and the electrolytic refining. 1200 w. Sib Jour of Engng—Nov., 1899. No. 30908 C.

Copper Solutions.

Copper Tubes and Sheets Direct from Solutions. On this method of refining copper and the products obtained. 800 w. Min & Sci Pr—Nov. 18, 1899. No. 30921.

GOLD AND SILVER.

Alaska.

The Cape Nome District, Alaska. Herbert Murray. Information gleaned while prospecting, and from well-informed miners. 1200 w. Eng & Min Jour—Nov. 25, 1899. No. 30958.

British Columbia.

The Atlin District in British Columbia. W. M. Brook. Information concerning this district, taken from the official report. Ill. 1300 w. Eng & Min Jour—Nov. 18, 1899. No. 30804.

The Bridge River Gold Mining Camp. Fritz Cirkel. Read before the Canadian Min. Inst. Describes location, deposits, etc. 3500 w. Can Min Rev—Oct. 31, 1899. No. 30580 B.

California.

The Emerson Shaft of the Wildman Mine, Sutter Creek, Cal. Illustrated description of a plant designed for deep mining. 700 w. Min & Sci Pr—Nov. 18, 1899. No. 30922.

The Vanderbilt Mining District, San Bernardino County, Cal. Report of this district and the peculiar vein system. 1700 w. Min & Sci Pr—Nov. 18, 1899. No. 30923.

Cyanide Plant.

Method of Working at the Taylor Mine Cyanide Plant, El Dorado County, Cal. E. F. Gropello. Illustrated detailed description of the plant and its operation. 1400 w. Min & Sci Pr—Oct. 28, 1899. No. 30581.

Permanganate.

The Permanganate Process of Gold Recovery. Describes this process, but does not think it has any extensive future before it. 900 w. Eng & Min Jour—Nov. 11, 1899. No. 30723.

Placer Deposits.

A Low-Grade Placer Proposition in Montana. Fred D. Smith. An illustrated account of a placer being worked, which yields less than 2c. to the yard. 800 w. Eng & Min Jour—Nov. 11, 1899. No. 30724.

Raven Hill.

Description of Raven Hill, Cripple Creek, and Its Ore Deposits. Arthur Lakes. Some of the peculiarities of the vein as shown in the Elkton mine. 1700 w. Mines & Min—Nov., 1899. No. 30640 C.

Sampling.

Some Notes on Mine Surface Sampling. S. H. Pearce. A discussion of methods used and the difficulties met. 6400 w. Jour Chem & Met Soc of S. Africa—Aug., 1899. No. 30689 E.

Silver Ores.

The Treatment of Dry Silver Ores in South America. A. A. Watson. Describes the methods used in Chili, Peru, and Bolivia. 2000 w. B C Min Rec—Nov., 1899. No. 30795 C.

Stamp Mills.

The "A" Battery Frame for Stamp Mills. Robert W. Barrell. Some of its advantages and a description of the method of constructing it. 1500 w. Mines & Min—Nov., 1899. No. 30645 C.

Transvaal.

Gold Production of Transvaal, 1899. From the London *Economist*. Data re-

specting the production. 500 w. U. S. Cons Repts, No. 567—Oct. 31, 1899. No. 30538 D.

Utah.

The Silver King Mine and Mill, Utah. H. L. J. Warren. Illustrated description. 1500 w. Eng & Min Jour—Nov. 4, 1899. No. 30596.

Washington.

The Republic Mining Camp, Washington. M. H. Joseph. A description of the country and camp, with historical account. Ill. 3300 w. Eng & Min Jour—Nov. 25, 1899. No. 30956.

IRON AND STEEL.

Blast Furnaces.

On Blast-Furnace Burdens. Walter Macfarlane. Read at the Dudley meeting of the South Staffordshire Iron & Steel Inst. Discusses various problems in the making of pig-iron. 2200 w. Ir & Coal Trds Rev—Nov. 3, 1899. No. 30768 A.

The Iron Making Blast Furnace as an Ideal Power Producer. Horace Allen. The first of a series of articles on the utilization of blast-furnace gases. 600 w. Am Mfr & Ir Wld—Nov. 9, 1899. Serial. 1st part. No. 30720.

Critical Ranges.

The Critical Ranges in Iron and Steel. H. M. Howe. A discussion of points in Mr. Osmond's discussion, with three amendments. 1300 w. Metallographist—Oct., 1899. No. 30815 F.

Cuban Ore.

Cuban Iron Ore. Editorial on a project for establishing an extensive iron and steel plant at Boston for the working of ores from Cuba and Spain. 2500 w. Engr, Lond—Nov. 17, 1899. No. 30999 A.

Hardened Steel.

The Constitution of Hardened Steel. Albert Sauveur. Presents the writer's opinion, which differs from the conclusions reached by Messrs. Arnold and McWilliams. Ill. 2000 w. Metallographist—Oct., 1899. No. 30817 F.

Iron Works.

Sixty Years in the Iron-Works. George Beard. Presidential address delivered to the West of Scotland Iron and Steel Inst. Discusses production, protection, and features of interest. 5300 w. Ir & St Trds Jour—Oct. 28, 1899. No. 30681 A.

Iron Mine.

The Mahoning Iron Mine. An illustrated account of this mine and its working. 1800 w. Ir Age—Nov. 9, 1899. No. 30673.

Iron Trade.

New Phases in the Iron Trade. Charles Kirchhoff. Address before Metal Section of the Manufacturers' Club, Philadelphia. 2500 w. Ir Age—Nov. 16, 1899. No. 30781.

Malleable Iron.

Physical Characteristics of Malleable Cast Iron. Erastus C. Wheeler. Considers the influence of heat conditions, chemical composition, annealing, test bars, etc. 2700 w. Ir Age—Nov. 9, 1899. Serial. 1st part. No. 30674.

Microscopic Analysis.

Practical Microscopic Analysis for Use in Steel Works. C. H. Ridsdale. Abstract of a paper read before the Iron & Steel Inst., of Great Britain. On the value of the microscope from the view of steel makers and users. 9000 w. Eng News—Nov. 2, 1899. No. 30685.

Nickel Steel.

Nickel Steel and Its Uses. R. A. Hadfield. Abstract of paper read before the Inst. of Civ. Engs. Describes several special applications of nickel steel. 3500 w. Ir & Coal Trds Rev—Nov. 17, 1899. No. 30980 A.

The Age of Nickel Steel. Harry J. Williams. Relates the facts concerning armor plate tests in 1890, and the effect on this product, also states its advantages. 2000 w. Ir Age—Nov. 9, 1899. No. 30675.

Open Hearth.

The Use of a Large Proportion of Soft Pig Iron in the Open Hearth Process (Martiniren bei Verwendung eines sehr Hohen Procentsatzes Weichen Roheisens). A. Sattman. A very complete description of an improved basic open-hearth process to be used continuously in direct connection with the blast furnace. 4500 w. Stahl und Eisen—Oct. 15, 1899. No. 31050 D.

Steel Works.

The Saarbrück Steel Works (Saarbrücker Gusstahlwerke). A general description of the works, with views showing the electric power plant and the electric driving. 1500 w. Stahl und Eisen—Nov. 1, 1899. No. 31053 D.

Structural Steel.

The Making of Structural Steel. F. H. Kindl. Read before the Am. Inst. of Archts., at Pittsburg. Describes the operations involved in the manufacture of structural shapes. 4500 w. Ir & Trd Rev—Nov. 16, 1899. No. 30793.

Temperatures.

Colors of Heated Steel Corresponding to Different Degrees of Temperatures. Maunsel White and F. W. Taylor. Notes of value to those handling steel. 500 w. Trans Am Soc of Mech Engs, No. 845—Dec., 1899. No. 30900 C.

On the Influence of Low Temperatures Upon Certain Steels. F. Osmond. A statement of experimental facts and their explanation. 900 w. Metallographist—Oct., 1899. No. 30816 F.

MINING.

Accidents.

Accidents from Falls of Roof and Sides. H. W. Holbaum. Considers the ways of most effectively dealing with this evil, discussing various opinions. 4200 w. Col Guard—Nov. 17, 1899. No. 30989 A.

Blasting.

Blasting in Mines. From *Allgemeine bergmännische Zeitschrift.* Discusses the choice of explosives, arrangement for charges, igniters, etc. 2000 w. Col Guard—Nov. 17, 1899. No. 30988 A.

China.

Boring for Gas and Petroleum in China. From *The Petroleum Industrial and Technical Review.* Information concerning the methods used, the products, and their uses in China. 1300 w. Sci Am Sup—Nov. 18, 1899. No. 30790.

Compass.

The Langer Compass Suspension for Use in the Vicinity of Iron (Das Langer'sche Hängezeng zur Verwendung des Compasses in Gegenwart von Eisen). H. Brathuhn. Illustrating and describing a form of suspension for a mining compass by which the relative deflection due to neighboring masses of iron may be determined. 1500 w. Oesterr Zeitschr f Berg u Hüttenwesen—Oct. 28, 1899. No. 31056 B.

Cuba.

Mining Conditions in Cuba. William B. Phillips. Describes the conditions under which mining is at present carried on. 2100 w. Eng & Min Jour—Nov. 25, 1899. No. 30957.

Deep Mining.

Mining at Great Depths. Reviews some of the great depths already reached and discusses proposed work, especially in the Witwatersrand. 1200 w. Engr, Lond—Nov. 3, 1899. No. 30760 A.

Depreciation.

Application of Different Methods of Depreciation to Mining Property. George Johnson. Shows the application of the four principal methods in ordinary use to mining property. 700 w. Col Guard—Nov. 10, 1899. No. 30878 A.

Systems of Recording Different Methods of Depreciation as Applied to Mining Property. George Johnson. Supplementary to a recent paper by the same writer. Describes modes of recording. 500 w. Col Guard—Nov. 17, 1899. No. 30990 A.

Drilling.

Diamond Drilling. H. M. Lane. Recovery of lost-rods, bits, and diamonds, and methods of obtaining cores from soft or soluble material. 2000 w. Mines & Min—Nov., 1899. No. 30642 C.

Speed of Drilling. Alfred C. Lane. Gives a table prepared by W. W. Stockly, with comments. 700 w. Eng & Min Jour—Nov. 4, 1899. No. 30597.

Dynamite.

Conditions for Safely Storing Dynamite in Underground Workings. From a report by M. H. Le Chatelier to the Commission des Substances Explosives, published in the *Annales des Mines.* An account of experiments for studying and determining the conditions. Ill. 2000 w. Col Guard—Oct. 27, 1899. No. 30625 A.

Electric Power.

Electricity in Coal Mining. John Price Jackson and Frank F. Thompson. Considers lighting, haulage, cutting or drilling, pumping and driving fans in soft coal mining. Also discussion. 4000 w. Trans Am Inst of Elec Engs—Oct., 1899. No. 30931 D.

Explosives.

New Home Office Test for High Explosives. Gives an account of a special test proposed in order to assist miners in the selection of a safe explosive for dangerous mines. 1300 w. Ir & Coal Trds Rev—Nov. 17, 1899. No. 30982 A.

Firedamp.

Apparent Cause of Error in Firedamp Determination by the Limits of Inflammability. M. Lebreton. From a communication to the *Annales des Mines.* Discusses the causes of variation. 1200 w. Col Guard—Nov. 3, 1899. No. 30762 A.

Handling.

Appliances for Handling and Storing Coal and Iron-Ore (Technische Hülfsmittel zur Beförderung und Lagerung von Kohlen und Eisenerzen). M. Buhle. With descriptions of numerous forms of conveyors and other handling devices of Continental, English, and American origin. Serial, Part I. 3000 w. Zeitschr d Ver Deutscher Ing—Oct. 14, 1899. No. 31026 D.

Haulage.

Rope Haulage in Mines. Describes the two systems, the endless rope, and the main and tail. 1500 w. Eng & Min Jour—Nov. 25, 1899. No. 30959.

The Rope Haulage Plant of the Coke Ovens at the Röchling Steel Works at Völklingen, in Altenwald (Die Machinelle Seilförderung auf der im Besitz der Röchlingschen Eisen und Stahlwerke zu Völklingen a. d. Saar Befindlichen Koksofen-Anlage in Altenwald). H.

Weihe. With numerous views showing the arrangement of cables and trackways. 2500 w. Glückauf—Oct. 14, 1899. No. 31059 B.

The Windber, Pa., Electric Haulage Plant. Illustrated description of the equipment and some figures as to operating expenses. 1200 w. Mines & Min—Nov., 1899. No. 30647 C.

Lamps.

A New Safety-Lamp Lock. M. H. Baugniet. From a communication to the Société des Ingenieurs des Mines du Hainaut. Briefly describes and illustrates three systems, investigated because of an explosion, caused by opening a lamp. Favors the Bomal lock, which depends upon a lead rivet. 2200 w. Col Guard—Nov. 17, 1899. No. 30992 A.

Improved Sussmann Lamp at the Strepy-Bracquegnies Collieries. Joseph Goffin. From a communication to Société des Ingenieurs des Mines du Hainaut. An illustrated description of the improved lamp. 1100 w. Col Guard—Nov. 10, 1899. No. 30879 A.

Mining Law.

The Field Mining Law. A new set of regulations that became effective in the State of Washington, June 9, 1899. 1700 w. Mines & Min—Nov., 1899. No. 30643 C.

The Rating of Colleries. Summary of British law and decisions. 3800 w. Col Guard—Nov. 3, 1899. No. 30763 A.

Motive Power.

Motive Power at the Mines. A. E. Chodzko. A discussion of the most desirable methods in the production of motive power at a mine. 1200 w. Min & Sci Pr—Nov. 18, 1899. Serial. 1st part. No. 30924.

Ore Deposits.

An Examination of the Ore Deposits at Rammelsberg near Goslar (Beitrag zur Kenntniss der Erzlagerstätte des Rammelsberges bei Goslar). Dr. Söhle. With geological map and sections showing the deposits of copper, lead, and sulphur, in this important district in Hanover. 3500 w. 2 plates. Oesterr Zeitschr f Berg u Hüttenwesen—Nov. 11, 1899. No. 31058 B.

Peru.

Peru and Its Mineral Wealth. Information from a pamphlet by Ernest Thorndike. 1600 w. Engr, Lond—Nov. 17, 1899. No. 30995 A.

Prospecting.

The Florissant Basin. Arthur Lakes. An account of a prospecting trip in the volcanic region between Cripple Creek and South Park. 2600 w. Mines & Min—Nov., 1899. No. 30644 C.

Rescue Work.

Rescue Work in Mines. Hugo Rössner, in *Oesterreichische Zeitschrift für Berg und Huttenwesen.* An account of the drill given in the use of the apparatus and appliances. 1100 w. Col Guard—Nov. 3, 1899. No. 30765 A.

Road-Making.

Road-Making on Mining Lands. Walter J. May. Some hints on the making of good roads out of available material. 900 w. Col Guard—Nov. 10, 1899. No. 30877 A.

Shaft Sinking.

Sinking a Shaft at the Bois-du-Luc Collieries. Adolphe Demeure. Translated from the *Annales des Mines de Belgique.* Illustrated description of an undertaking where certain improvements were introduced to facilitate operations. 3000 w. Ir & Coal Trds Rev—Nov. 17, 1899. No. 30981 A.

South Africa.

South Africa from an Engineering Standpoint. Albert Williams, Jr. An impartial expert review of the causes leading up to the Boer war, the general conditions under which mining has been conducted, the expansion certain to follow under just and liberal government, and the interest of the engineering world in the newly opening African empire. 4000 w. Engineering Magazine—Dec., 1899. No. 13090 B.

Stoping.

Machine Drills in Stoping. B. L. Thane. An outline of the writer's experience in Alaska, with discussion of the work and its difficulties. 2800 w. Aust Min Stand—Sept. 28, 1899. No. 30676 B.

Surveying.

A Geological Survey of a Mining Property. T. C. Hopkins. The details which must be determined, and how they should be shown on the map and notes. 1800 w. Mines & Min—Nov., 1899. No. 30646 C.

Ventilators.

Comparative Experiments with Capell and Mortier Ventilators at the Bonifacius Mine (Vergleichende Versuche mit Einem Capell und Einem Mortier Ventilator auf Zeche "ver. Bonifacius"). Both fans were electrically driven, and the methods of test are given in detail; also tables of results and graphical diagrams. 4000 w. 2 plates. Glückauf—Oct. 28, 1899. No. 31060 B.

Winding Engine.

The Compound Winding Engine, its Operation and Steam Consumption (Ueber Compound Fördermaschinen, deren Betriebs und Dampfconsumverhältnisse). Julius Divis. A general re-

view of the advantages of the compound engine for mine hoists, giving methods of computing cylinder ratios, and general proportions for this especial service. Serial. Part I. 2500 w. Oesterr Zeitschr f Berg u Hüttenwesen—Nov. 4, 1899. No. 31057 B.

MISCELLANY.

Alloys.

Concerning Alloys (Ueber Legirungen). A review of the recent progress of knowledge in the nature of alloys and the manner in which metals unite when fused together. 3500 w. Stahl und Eisen—Oct. 15, 1899. No. 31051 D.

Microstructure of Alloys. J. E. Stead. Considers alloys of antimony and tin, antimony and copper, and copper and tin. Ill. 6000 w. Metallographist—Oct., 1899. No. 30818 F.

On the Dilatation of Metallic Alloys. H. Le Chatelier. Gives results of researches concerning the determination of the dilatation. Ill. 2500 w. Metallographist—Oct., 1899. No. 30819 F.

Corundum.

Notes on the Corundum-Bearing Rocks of Eastern Ontario, Canada. Willet G. Miller. Describes these deposits. 1800 w. Am Geol—Nov., 1899. No. 30979 D.

Diamonds.

The Parent-Rock of the South African Diamond. T. G. Bonney. The substance of a paper, read before the Royal Society, giving an account of investigations made and conclusions reached. 1200 w. Nature—Oct 26, 1899. No. 30613 A.

Education.

Technical Education for Miners in the Wigan District. C. M. Percy. Describes the endeavors to provide education appertaining to mining, in the Wigan coalfield. 2300 w. Col Guard—Nov. 3, 1899. No. 30764 A.

Graphite.

Graphite. J. Ohly. A description of its occurrence and properties. 1200 w. Min Rept—Nov. 2, 1899. Serial. 1st part. No. 30619.

Lead.

A Liquid from the Fumes of Lead Furnaces. Malvern W. Iles. A study of the chemical reactions which take place in the lead blast furnace. 1600 w. Eng & Min Jour—Nov. 11, 1899. No. 30725.

Manganese.

The Manganese Industry in Southern Russia (Ueber die Mangan-Eisen Industrie in Sudrussland). F. W. Lürmann. A brief account of the various works, and statistics of their product from 1893 to 1898. 1800 w. Stahl und Eisen—Oct. 15, 1899. No. 31049 D.

Mica.

The Occurence and Uses of Mica. M. L. Fuller. History of the mining of this mineral in early times, with interesting facts relating to the deposits and uses. 1400 w. Stone—Nov., 1899. No. 31109 C.

Minerals.

The Mineral Industry of Great Britain. Facts given in a series of articles in an English publication form the basis of the information presented. 3200 w. Stone—Nov., 1899. No. 31111 C.

Photography.

Interior Photography. Louis Allen Osborne. The difficulties of photographing interiors of breakers and mills and how they may be overcome. Ill. 3800 w. Mines & Min—Nov., 1899. No. 30638 C.

Rubies.

On a New Mode of Occurrence of Ruby in North Carolina. J. W. Judd and W. E. Hidden. Describes discoveries in the State of North Carolina. Ill. 3800 w. Am Jour of Sci—Nov., 1899. No. 30554 D.

RAILWAY AFFAIRS

CONDUCTING TRANSPORTATION.

Accidents.

Train Accidents in the United States in September. Detailed list and classified summary, with remarks 4400 w. R R Gaz—Nov. 10, 1899. No. 30734.

Austria.

Express Train Speeds in Austria (Schnellzugs-Geschwindigkeiten in Oesterreich). F. Ross. A comparison of the moderate speeds of Austrian express trains with the much higher speeds regularly attained in other parts of Europe and in the United States 1200 w. Zeitschr d Oesterr Ing u Arch Ver—Nov. 10, 1899. No. 31022 B.

Employees.

Physical Fitness of Employees. R. C. Richards. Read at meeting of the N. Y. State Assn. of Ry. Surgeons. Gives information obtained from special examina-

tions, with views of the writer. 3800 w. Ry Age—Nov. 24, 1899. No. 30963.

German Trains.

Census of German Express Trains. Information from census made by J. P. Pattinson aiming principally at an estimate of the speed. 300 w. R R Gaz—Nov. 10, 1899. No. 30737.

Railroad Policy.

The Retirement of President Clark. Clarence Deming. Reviews the twelve years during which President C. P. Clark controlled the New York, New Haven and Hartford (Consolidated) Railroad Company, paying tribute also to his fine personality. 1400 w. R R Gaz—Nov. 24, 1899. No. 30943.

Transportation.

American Railroads. George H. Daniels. Address before the International Commercial Congress, at Philadelphia. Discussing their relation to commercial, industrial, and agricultural interests. 3500 w. Sci Am Sup—Nov. 18, 1899. Serial. 1st part. No. 30789.

A Railroad Confession of Faith. Statement submitted by Mr. Paul Morton, of the A., T. & S. F. Ry. to the Industrial Commission in session at Chicago. 2500 w. Ry & Engng Rev—Nov. 25, 1899. No. 31112.

Rail vs. Water Transportation: A Defence of the Latter. Letter from Chauncey N. Dutton, with editorial reply. 3000 w. Eng News—Nov. 23, 1899. No. 30915.

Vision.

Examination for Defects of Vision. Dr. Charles H. Williams. Condensed paper read before the Am. Med. Assn., at Columbus, O. Tests in connection with the semaphore signal are discussed, also color perception tests, and methods used. 3200 w. R R Gaz—Nov. 17, 1899. No. 30805.

MOTIVE POWER AND EQUIPMENT.

Air Brakes.

Inspection and Maintenance of Air Brakes. Extracts from the report presented at the Nov. meeting of the Central Ry. Club. 900 w. R R Gaz—Nov. 17, 1899. No. 30808.

Armored Trains.

Armor-Protected Troops. Discusses armored trains, armored motor-cars, and coats-of-mail. 2000 w. Engr, Lond—Nov. 3, 1899. No. 30759 A.

Boilers.

See Mechanical Engineering, Steam Engineering.

Box Cars.

A Typical Box Car. Extracts from discussion at meeting of the Western Railway Club, on the subject, "What Would Be the Advantage to Railroads in Adopting a Box Car of Typical Inside Dimensions?" 3200 w. R R Gaz—Nov. 24, 1899. No. 30944.

Uniform Dimensions for a Typical Box Car. Discussions by Messrs. A. M. Waitt, and R. P. C. Sanderson. 5000 w. N Y R R Club—Oct. 19, 1899. No. 30882.

Car Temperature.

Automatic Temperature Control for Passenger Cars. Illustrates and describes a modification of the Powers system, which has been tried with success on a number of roads. 1100 w. R R Gaz—Nov. 17, 1899. No. 30806.

Combination Cars.

New 80,000 Lbs. Capacity Combination Coal and Ballast Cars for the Illinois Central. Illustrated description. 800 w. R R Gaz—Nov. 3, 1899. No. 30593.

Couplings.

Double Drawbar Car Couplings. H. M. Lane. Illustrates how they can be arranged to afford safety in hauling trains on steep inclines. 1000 w. Mines & Min—Nov., 1899. No. 30641 C.

The Brockelbank Railway Wagon Coupling. Illustrated description with statement of advantages. 700 w. Engng—Nov. 17, 1899. No. 30986 A.

Electricity vs. Steam.

Electricity versus Steam for Branch Railroad Lines. Charles H. Davis. Continued discussion. 30600 w. Pro Am Soc of Civ Engs—Nov., 1899. No. 30938 E.

Fireboxes.

Wider Fireboxes. William Forsyth. A discussion of grate area and its relation to cylinder volume. 2000 w. Am Engs & R R Jour—Nov., 1899. No. 30559 C.

Flanges.

Sharp Flanges—Their Causes and Remedies. C. C. Borton. Extracts from a paper read before the Pacific Coast Ry. Club. Discusses faults in car construction that produce flange wear. 1400 w. R R Gaz—Nov. 3, 1899. No. 30589.

Locomotive Construction.

The Working Stress of Materials Used in British Locomotive Construction. F. W. Jennings. Read before the Northeast Coast Inst. of Engs. & Shipbuilders. An investigation of the stresses usually allowed on some of the more important parts of the locomotive. 3500 w. Engng—Nov. 10, 1899. No. 30876 A.

Locomotives.

American Tank Locomotives for Foreign Railways. Illustrates and describes

two types of engines rarely used in American practice. 1400 w. Eng News—Nov. 16, 1899. No. 30801.

Baldwin Six Coupled Locomotive—Cambria Steel Co. Illustrates and describes a handsome modern switching locomotive. 500 w. Ry & Engng Rev—Nov. 18, 1899. No. 30851.

Double End Consolidation Locomotive—Dominion Coal Co. Illustrated description of an engine built at the Schenectady Locomotive Works, and sent to Cape Breton, Nova Scotia. 700 w. Ry & Engng Rev—Nov. 4, 1899. No. 30668.

Eight Coupled Tank Locomotive—Port Talbot Railway and Dock Co. Illustrated description of a locomotive for South Wales. 700 w. Ry & Engng Rev—Nov. 25, 1899. No. 31113.

Locomotives for the Southern Railway of France. Considers in some detail the several most advanced types of locomotives that have been brought into service by this company, giving illustrations. 2700 w. Engng—Nov. 10, 1899. No. 30874 A.

Locomotive Tank Engines. Illustration and specifications of one of two tank engines built for the Central London Ry. 1800 w. Engr, Lond—Nov. 17, 1899. No. 30997 A.

Some Deductions from Road Tests of Locomotives. R. P. C. Sanderson. Calls attention to some of the causes which may seriously affect the results of road tests and lead to erroneous conclusions. Discussion. 10000 w. N Y R R Club—Sept. 21, 1899. No. 30750.

Ten-Wheel Express Locomotive for the North-Eastern Railway, England. Elevation and plan, with dimensions and description. Also editorial. 1000 w. R R Gaz—Nov. 10, 1899. No. 30735.

Ten-Wheel Passenger Locomotives. W. H. Marshall's design for use on the Lake Shore & Michigan Southern Ry. is described and illustrated. 1200 w. Am Engr & R R Jour—Nov., 1899. No. 30558 C.

The Heaviest Passenger Locomotive Ever Built, L. S. & M. S. Ry. Illustrated description, with dimensions and comments. Also table. 1300 w. Eng News—Nov. 9, 1899. No. 30694.

Paints.

Durability of Different Colors of Paints for Passenger and Freight Equipment. T. S. Lloyd. Read before the South & Southwest Railway Club. Considers yellow (or orange), Tuscan red and Pullman color. 1500 w. R R Car Jour—Nov., 1899. No. 30746.

Signaling.

Automatic Signaling and Stopping of Trains at Grade Crossings. Illustrated description of an interlocking plant with automatic signals, supplemented on one line by the Rowell-Potter safety stop for automatically applying the brakes should a train try to run past a signal. 1000 w. Eng News—Nov. 16, 1899. No. 30802.

Automatic Signals; Normal Safety or Normal Danger. A. J. Wilson. Presented at Boston meeting of the Railway Signaling Club. Favors the normal danger system as more economical in operation. 600 w. Eng News—Nov. 9, 1899. No. 30699.

Mechanical Fog Signaling Apparatus. Describes a system invented by V. L. Raven and Charles Baister. Ill. 3300 w. Engr, Lond—Nov. 10, 1899. No. 30865 A.

Possibilities of Three-Position Signalling. Frank Rhea. Condensed from a paper presented at Boston meeting of the Railway Signal Club. Discusses the possibilities of three-position signals used with an automatic block system, and with interlocking. 1100 w. Eng News—Nov. 16, 1899. No. 30797.

Progress in Signalling. H. M. Sperry. Prepared for the Boston meeting of the Railway Signalling Club. Review of improvements and advances. 1100 w. R R Gaz—Nov. 3, 1899. No. 30591.

Stability.

Stability of Motion of Vehicles. Discusses the disturbing causes affecting the motion of railroad cars. 1500 w. R R Car Jour—Nov., 1899. No. 30745.

Train.

A Handsome Train. Describes a train soon to be placed on the Chicago & Alton Ry., between Chicago and St. Louis, for a daylight limited service. 800 w. Ry & Engng Rev—Nov. 18, 1899. No. 30850.

Train Lighting.

The Dick System for Electric Train Lighting (Emil Dick's Anordnung für Elektrische Zugbeleuchtung). L. Kohlfürst. The lamps are supplied from accumulators in the respective cars, the accumulators being charged from a dynamo attached to the axle of the baggage car. 3000 w. Schweizerische Bauzeitung—Oct. 21, 1899. No. 31044 B.

Trucks.

Transporting Trucks (Trucks-Transporteurs). M. Claise. Illustrated description of the independent trucks used on the Ardennes narrow-gauge railway for the transport of pieces for which the cars are unsuited. 10000 w. 1 plate. Ann des Ponts et Chausées, 2 Trimestre, 1899. No. 31080 E + F.

NEW PROJECTS

Anatolia.

Germany's Survey for the Bagdad Railway. Brief account of the route being investigated. 700 w. Engr, Lond—Oct, 27, 1899. No. 30624 A.

Mont Blanc.

A Railway Up Mount Blanc. A report made by a scientific commission upon the suggested railway. Translated from *La Revue Alpine.* 2000 w. Engr, Lond—Nov. 17, 1899. No. 31100 A.

New South Wales.

The Railways of New South Wales. Extracts from a recently published review giving information of the progress during the last ten years. Ill. 1000 w. Ry Age—Nov. 24, 1899. No. 30964.

Scotland.

The Invergarry and Fort Augustus Railway. Describes the route and construction of this line. Map. 2000 w. Engr, Lond—Nov. 17, 1899. No. 30993 A.

PERMANENT WAY AND FIXTURES.

Early Construction.

Early Railway Construction in the United States. Abstract from "Poor's Manual," reviewing the railway system from its beginning in 1828. 2200 w. Eng News—Nov. 9, 1899. No. 30695.

Cross Ties.

Steel Ties on the Sumatra State Railways. Information from the report made by L. K. Lindhout, and printed in the Bulletin of the International Railway Congress. 1300 w. Eng. News—Nov. 23, 1899. No. 30917.

The Crosstie Situation. Editorial on the use of metal ties and other materials. 1200 w. R R Gaz—Nov. 17, 1899. No. 30807.

Grades.

Grade Reductions on the Illinois Central in Tennessee. Information relating to work between Fulton, Ky., and Memphis, Tenn. Map and Ills. 800 w. Ry & Engng Rev—Nov. 18, 1899. No. 30849.

Paris.

The Prolongation of the Orleans Railway (Prolongement de la Ligne d'Orléans). Alfred Boudon. A fully illustrated account of the present state of the works, showing the construction of the subway along the Seine, and the terminal on the Quai d'Orsay. 3000 w. Génie Civil—Oct. 28, 1899. No. 31003 D.

Single Rail.

Behr's Single-Rail High-Speed Railway (Ueber Behr's Einschienbahn und Hohe Schnellzug-Geschwindigkeiten). Rolf Sanzin. A discussion of the single rail high-speed road proposed by Behr for use between Liverpool and Manchester. 4000 w. Zeitschr d Oesterr Ing u Arch Ver—Oct. 20, 1899. No. 31018 B.

Station.

A New Union Station at Richmond, Va. Illustration and plans are given, with brief description of the proposed building. 600 w. Ry Age—Nov. 3, 1899. No. 30609.

Station Grounds.

The Embellishment of Railroad Station Grounds. A. Reinisch. On the treatment such grounds should receive. 1500 w. R R Gaz—Nov. 3, 1899 No. 30592.

Terminal.

Western Railway of Alabama Terminal Improvements, at Montgomery, Ala. Plans and illustration, with brief description. 900 w. Ry & Engng Rev—Nov. 11, 1899. No. 30747.

Tunnel.

See Civil Engineering, Construction.

Track Thrower.

The Creese Track Thrower. Illustrates and describes a recently invented machine and its operation. 500 w. Ry & Engng Rev—Oct. 28, 1899. No. 30537.

TRAFFIC.

Haulage.

Economical Haulage. Editorial discussion of American practice as compared with English. 2000 w. Engr, Lond—Nov. 17, 1899. No. 30998 A.

Trainloads.

What Do We Mean by a Trainload? Editorial discussion of the misleading use of this term. 1500 w. R R Gaz—Nov. 3, 1899. No. 30594.

STREET AND ELECTRIC TRAMWAYS

Brake.

Compressed Air Brake for Electric Tramways (Frein à Air Comprimé pour Voitures de Tramways Electriques). An illustrated description of the standard air brakes, as applied on the electric tramway operated by the *Chemin de fer de l'Ouest,* between the Invalides and Versailles. 1800 w. L'Electricien—Nov. 4, 1899. No. 31087 B.

Cable.

Swansea Constitution Hill Tramway. Illustrates and describes an interesting little cable tramway, where the cable is not continuous, but is attached at either end to a car. 1000 w. Tram & Ry Wld—Nov. 2, 1899. No. 30813 A.

Central America.

An Electric Railway in Central Amer-

ica. Dan Wells Casement. Illustrated detailed description of the equipment of the road at San José, Costa Rica. 1200 w. Am Elect'n—Nov., 1899. No. 30599.

Contact System.

Anderson's Surface Contact Tramway System. Illustrated description of the apparatus and statement of the operation. 2200 w. Tram & Ry Wld—Nov. 2, 1899. No. 30814 A.

Detroit.

Detroit's Effort to Own Her Street Railways. Edward W. Bemis. Gives the history of the street railways and the movement for municipal ownership. 7500 w. Munic Affairs—Sept., 1899. No. 30-683 C.

Electrolysis.

Electrolysis—From the Standpoint of the Municipal Electrician. H. S. Wynkoop. Read before the Am. Soc. of Munic. Imp. States the conditions in Brooklyn, and the attitude of the municipality. 2000 w. Munic Engng—Nov., 1899. No. 30575 C.

France.

The Development of the Tramways of France (L'Exploitation des Tramways en France). Charles Jean. A tabulated view, showing the costs of installation and operation for the various kinds of tramway traction now in operation in France. Serial. Part I. 3000 w. Génie Civil—Nov. 4, 1899. No. 31005 D.

Great Britain.

Electric Tramways and British Industry. Hawthorne Hill. On the obstacles met in England by electric railway companies, and their effect on the industrial situation. 1400 w. Ir Age—Nov. 23, 1899. No. 30909.

Java.

Electric Traction in Java. An illustrated description of a new tramway in Batavia, taken from *Elektrotechnische Zeitschrift*. 1000 w. Elec Eng, Lond—Nov. 17, 1899. Serial. 1st part. No. 30-971 A.

The Electric Tramway in Batavia (Die Elektrische Strassenbahn in Batavia). An excellent account of this overhead trolley line, the first in the Dutch West Indies, with numerous illustrations. 4500 w. Elektrotech Zeitschr—Oct. 26, 1899. No. 31067 B.

Power House Engines.

See Mechanical Engineering, Steam Engineering.

Rapid Transit.

The Contract for the New York Rapid Transit Railway. An editorial summary of the conditions under which it is proposed to carry out this work. 2000 w. Eng News—Nov. 23, 1899. No. 30914.

Sheffield.

The Sheffield Corporation Tramways. Illustrated detailed description. 3500 w. Tram & Ry Wld—Nov. 2, 1899. No. 30-812 A.

Track.

A Novelty in Street Railway Track. Describes a track with 60 ft., 57 lb., T rails, supported at the joints by inverted pieces of the same section riveted base to base. The rails are laid on longitudinal beams of concrete. 600 w. Eng Rec—Nov. 11, 1899. No. 30704.

The Construction and Maintenance of Street Tracks. Describes the work in Kansas City, which has the rails supported on longitudinal beams of concrete. 1800 w. Eng Rec—Nov. 11, 1899. No. 30709.

Track Construction Used in Scranton, Pa. Frank Silliman, Jr. Read before the Penn. St. Ry. Assn. Illustrated description. 700 w. St Ry Rev—Nov. 15, 1899.—No. 30871 C.

Trucks.

Car Trucks. W. H. Heulings, Jr. Read at the Lancaster meeting of the Penn. St. Ry. Assn. Favors the use of the maximum traction truck. 4200 w. St Ry Rev—Nov. 15, 1899. No. 30870 C.

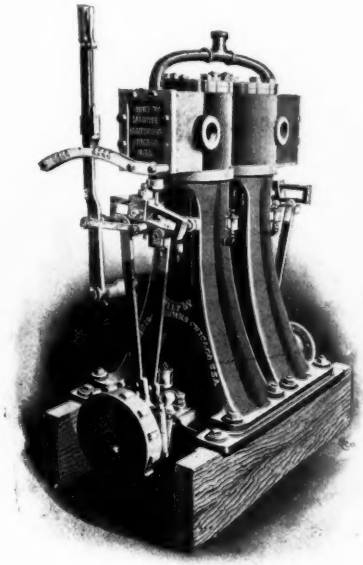
IMPROVED MACHINERY

New Processes and New Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

A Double Marine Engine.

THE cut herewith represents one of a new line of double engines which the Marine Iron Works, Chicago, have just brought out, and is distinctly different from their light weight yacht engines of the column frame design in that it is designed,



built and fitted out for heavy, hard service with special reference to durability and ample wearing surfaces. These new double engines have balanced slide valves suited to the highest working pressures and piston speed, and at present are made in six sizes, viz.: double, 5 x 5; double, 6 x 7; double, 7 x 7; double, 8 x 8; double, 9 x 10, and double, 10 x 10. As will be seen by the illustration, the design of the solid bedplate is such that ample lengths for connecting and eccentric rods are allowed, and yet the greatest weights are low down in the boat. This makes the firmest possible foundation and renders accurate and easy lining-up a practical certainty.

The double throw crank shaft (cranks set on the quarter) is slotted out from the solid forging, and is counterbalanced. The connecting and eccentric rods, link lifters, levers, etc., are forgings. Each engine is fitted out complete, including the steam connection between the two cylinders, ready for main steam pipe from boiler, oil cups, grease cups, cylinder drain valves and engine wrenches.

An inquiry addressed Marine Iron Works, Chicago, will bring out such further data as may be desired, such as prices, weights, floor space, etc.

Armstrong Planer Tool.

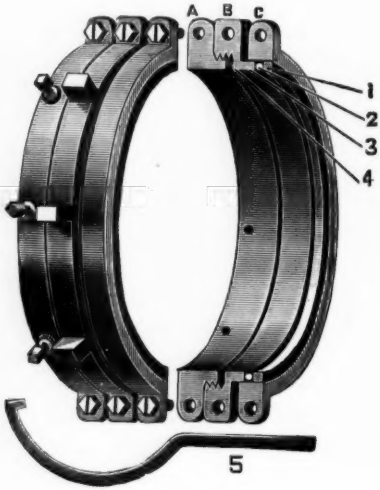
THE accompanying illustration represents a new planer tool brought out by the Armstrong Bros. Tool Co., Chicago, Ill. This tool is especially adapted for the economical use of self-hardening steel in planer and shaper work. The shank is drop-forged of steel and is case hardened. The cutters are self-hardening steel, rectangular in shape, and of stock sizes. By means of grooved seats into which they are placed the cutters may be quickly adjusted to any desirable angle, and at the same time so locked into position as to render slipping impossible. Rectangular-shaped steel is considered by the workers as preferable to square for a planer tool cutter, as it is not only stiffer, but admits of being ground with more side rake. This form of cutter also admits of sharpening oftener without the necessity of reshaping the point. This tool can be used either right or left hand, and when desirable or necessary, as, for instance, when cutting a keyway, it may, by reversing the cutter and turning the tool around, be transformed

into the equivalent of a "goose neck" tool. This improved tool is made in five sizes,

and the manufacturers will be glad to furnish additional information on request.

Steam Joint Clamp.

To repair leaks in steam joints without pulling out the pipe or shutting down the plant has long been a problem. James McCrea & Co., Chicago, Ill., are now marketing the Climax steam joint clamp, shown in the accompanying wood engraving,

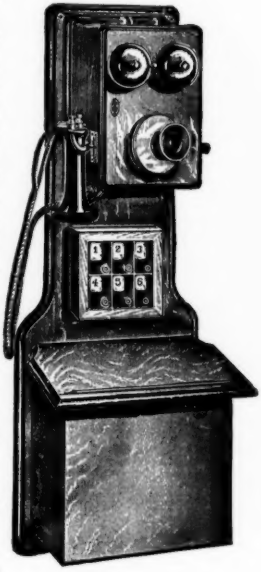


which, it is maintained, will permanently stop the leak, and, because of its simple and convenient construction, may be applied in a few minutes while the steam is on the pipe. The clamp occupies only 2½ inches space on the pipe, and lies so close that the pipe-covering may be replaced over it. In the cut herewith *A* is a rigid clamp, with mole thread, held firmly to the pipe by set screws; *B* is a loose clamp with female thread, and lugs for spanner; *C* is a loose clamp, holding packing and follower ring. When *B* is screwed away from *A* it forces the packing through *C* to the joint. These clamps are made in halves, held together by set screws, and may be had in all sizes from ¾ inch to 20 inches.

Further particulars will be furnished by the makers in answer to inquiry.

Industrial Telephone.

The Eureka Electric Co., of Chicago, Ill., U. S. A., are placing upon the market a most complete line of high grade telephones and switch-board apparatus. Their line embraces everything necessary to equip a complete exchange, toll line or a private interior system, either inter-communicating or with switch-board. This company have equipped within the last year over 500 complete independent telephone exchanges in the United States and foreign countries, and their apparatus has met with deserved success. The cut shown herewith is of their No. 71 combination switch-board and telephone combined for small branch toll line exchanges or small interior exchanges. It is capable of furnishing the most exacting service and is sold at a very reasonable price. The company will be pleased to give special information concerning all of their instruments, and also forward illustrated catalogue matter concerning their apparatus upon application.



NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Merchant & Co., Inc., Philadelphia, Pa., U. S. A.—Catalogue of seamless tubes of brass and copper, giving analyses of composition, reports of the results of tests, and useful rules for the determination of safe limit of bursting pressure. A list of war and merchant vessels on which these tubes are used is appended.

Northern Engineering Works, Detroit, Mich., U. S. A.—Pamphlet of tumblers for foundry use, with specifications showing space occupied, and plans giving methods of mounting tumblers in batteries of any number. A telegraph code is included.

Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.—Catalogue No. 101, devoted to machinist's tools and measuring tools, including steel rules, scales, protractors, bevel gauges, and similar tools; also micrometer calipers, gear tooth gauges, and gauges for screw threads. The catalogue contains a number of valuable tables relating to the use of gauges, conversion or metric equivalents, and proportions of gear teeth.

Charles H. Paine, New York.—Pamphlet of steam appliances of copper and cast iron, including the Wainwright even-flow horizontal water-tube heater, and Wainwright expansion joint.

The Acetylene Generator Manufacturing Co., Cincinnati, Ohio, U. S. A.—Catalogue describing the Beck automatic acetylene gas generator, and giving comparative data about the illuminating power of acetylene, coal gas and incandescent electric lights.

Joseph Dixon Crucible Company, Jersey City, N. J., U. S. A.—Catalogue about Dixon's flake graphite, showing its great value as a lubricant, especially in connection with the bearings of locomotive engines. Data from the tests of Professors Thurston and Kingsbury are given, showing the superior lubricating qualities of graphite, and a large number of testimonials from users are appended.

B. F. Sturtevant Co., Boston, Mass., U. S. A.—Circular of the Sturtevant exhaust head for the removal of entrained water and oil from exhaust steam. Tables of sizes, dimensions, and weights are given.

Whiting Foundry Equipment Co., Harvey, Ill., U S.. A.—Fully illustrated catalogue of cranes and air hoists, giving full details of electric traveling cranes, also hand-power cranes of the jib, gantry, and pillar types. A variety of air hoists are also shown, and many illustrations of the interiors of foundries, with the appliances in use, are given.

The Westinghouse Air Brake Company, Pittsburg, Pa., U. S. A.—Handsome catalogue of the Westinghouse electro-pneumatic system for controlling railway and other motors. The apparatus, which is fully described, permits the simultaneous control of any number of electric motors on a train from one point. The adaptation of the Westinghouse air brake to electric cars is also shown.

Westinghouse Electric and Manufacturing Co., Pittsburg, Pa., U. S. A.—Catalogue of Westinghouse railway motors, showing the general arrangement of motors and trucks for various kinds of tramway and other service. Illustrations of a number of typical Westinghouse railway power stations are also given.

Baldwin Locomotive Works, Philadelphia, Pa., U. S. A.—Record of recent construction *(a)* No. 15, devoted to the Wooten boiler, being the discussion of a paper by Mr. S. M. Vauclain at the New York Railway Club, and giving detailed drawings of boilers and illustrations of locomotives; *(b)* No. 16, illustrations with specifications in English and French, of engines built for England, Burma, China, Finland, Mexico, Brazil, and various parts of the United States.

The Illinois Steel Company, Chicago, Ill., U. S. A.—Catalogue of Steel Portland Cement, being cement manufactured from furnace slag. The method of manufacture is described, and a great number of important illustrations upon which this cement has been used are also given. To these are appended reports of tests by Government and private engineers and many testimonials from users.

Tompkins Brothers, Troy, N. Y., U. S. A.—Catalogue No. 4, devoted to knitting machinery, winders, washers, burrs, etc., with many handsome illustrations, and instructions as to the care and operation of the machines.

Standard Railway Equipment Company, St. Louis, Mo., U. S. A.—Catalogue of pneumatic tools for chipping, caulking, riveting, drilling, and similar work, especially adapted for railway car works, boiler shops, and similar service. Excellent illustrations exhibiting the many applications of the tool are given.

Bullock Electric Mfg. Company, Cincinnati, Ohio, U. S. A.—Bulletins *(a)* No. 0628, showing the application of the Bullock electric power system to the operation of newspaper presses; *(b)* No. 0635, illustrating direct-current multipolar motors, and showing their applicability to the direct driving of machine tools.

Westinghouse, Church, Kerr & Co., New York.—A very artistically prepared brochure relating to light and power installations for private residences and hotels and setting forth especially the applicability of the Westinghouse gas engine for use in connection with private electric lighting plants. The work is most beautifully designed and printed.

NEW CATALOGUES.

Gleason-Peters Air Pump Company, New York—Pamphlet catalogue of air pumps, both hand and power for bicycles, motor vehicles, and for physicians' and experimental purposes. Outfits for blowing whistles, fog horns, etc., are listed, and a full assortment of parts.

Buffalo Forge Company, Buffalo, N. Y., U. S. A.—Mailing card illustrating the Buffalo disk wheels, of electric, steam, and pulley types, for ventilation, cooling, and drying, and for the removal of fumes, smoke, dust, etc.

The Middletown Machine Company, Middletown, Ohio, U. S. A.—Catalogue of the Miami gas and gasoline engine, with many handsome illustrations showing the construction of details of the engine, also directions as to the care and operation of gas engines in general.

National Meter Company, New York.—Catalogue of the Nash gas and gasoline engine, showing its adaptability to electric lighting, pumping, and power purposes generally. Valuable data as to the cost of operating the engines with various kinds of fuel are also given.

Central Fire-proofing Company, New York.—Advance sheets from a forthcoming catalogue relating to terra cotta fire-proofing. Many useful diagrams and tables are given enabling the safe loads for various forms of flat arches to be determined, together with illustrations of typical methods of construction adapted to a great variety of cases.

The Shaw-Walker Company, Muskegon, Mich., U. S. A.—Pamphlet describing the Shaw-Walker card catalogue system, showing the great advantage of card systems over books, and giving many examples of the manner in which cards can be used to advantage. Many handsome styles of card cabinets are also shown.

William Sellers & Co., Incorporated, Philadelphia, Pa., U. S. A.—Handsomely bound volume containing general description and illustrations of the improved machine tools for working metal built by this well-known firm, including lathes, planers, riveting machines, boring and drilling machines, testing machinery, injectors, cranes, etc., etc., the whole forming a valuable treatise on machine tools of the highest type.

Sprague Electric Company, New York.—Catalogues *(a)* No. 64, of Lundell generators, both of the direct connected and the belted types, with numerous fine illustrations of the machines and details; *(b)* No. 75, of interior conduits, insulating fittings, tools, etc.; *(c)* pamphlet of instructions for the proper installation of flexible metallic conduit.

Robins Conveying Belt Co., New York.—Catalogue of belt conveyors, showing details of construction and numerous handsome illustrations of important installations for handling grain, coal, ore, sand, gravel, broken stone and other heavy, rough, and difficult material.

Harrison Bros. & Co., Philadelphia, Pa., U. S. A.—Unique pamphlet entitled "One Hundred Years of Successful Paint Making," giving history of the firm and details of its work. The brochure has a handsome poster cover, and is a tasteful example of the printer's and stationer's art.

Warren Manufacturing Co., Chicago, Ill., U. S. A.—Pamphlets describing a liquid for coating the surfaces of belt pulleys in order to increase the adhesion and prevent the slipping of belts. The advantages of the material for textile manufactories, and electric plants are set forth.

Ransome Construction Co., Philadelphia, Pa., U. S. A.—Catalogue describing the system of reinforced concrete construction, using cold twisted steel as a reinforcing material. Illustrations of numerous installations of the Ransome system are given.

Daimler Manufacturing Company, New York.—Handsomely illustrated catalogue of the marine department, showing the numerous applications of the Daimler gasoline motors as adapted to the operation of launches, yachts, and other boats. Views in the workshops and boat yards are given, and illustrations and specifications of equipments for every variety of service.

Theodore Alteneder & Sons, Philadelphia, Pa., U. S. A.—Catalogue of drawing instruments, scales, drawing boards, and other supplies for draftsmen, also the Sexton Omnimetre, or circular slide rule.

Gates Iron Works, Chicago, Ill., U. S. A.—Catalogue No. 15, devoted especially to machinery for cement works, including crushers, rock breakers, rolls, kilns, screens, elevators, conveyors, etc., with useful information relating to cement machinery.

Fox Machine Co., Grand Rapids, Mich., U. S. A.—Pamphlet catalogues *(a)* of bicycle tools, including rim and hub drills, vises, brazing forges, presses, assembling stands, etc., and *(b)* of the Fox tube or pipe-cutting machine, adapted for cutting heavy tubing, steam pipe, etc.

The Ball Engine Company, Erie, Pa., U. S. A.—Pamphlet catalogue of self-oiling automatic steam engines, with illustrations showing the manner in which the working parts are so enclosed as to be thoroughly lubricated by the circulation of the enclosed oil.

The New Process Rawhide Company, Syracuse, N. Y., U. S. A.—Pamphlet setting forth the advantages of rawhide pinions, and calling attention in particular to their adaptability for the peculiarly exacting demands of motor vehicle service.